VOLUME XV May 1926 NUMBER 5

1928 8 JUN Medical Lib.

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

OFFICIAL ORGAN
THE AMERICAN ROENTGEN RAY SOCIETY
THE AMERICAN RADIUM SOCIETY

Editor: ARTHUR C. CHRISTIE, M.D.

EDITORIAL BOARD
JAMES T. CASE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

ADVISORY BOARD FOR PATHOLOGY
JAMES EWING, M.D. Cornell University
EUGENE L. OPIE, M.D. University of Pennsylvania
ALDRED S. WARTHIN, M.D. University of Michigan

PUBLISHED MONTHLY FOR THE AMERICAN ROENTGEN RAY SOCIETY
BY PAUL B. HOEBER, INC., 67-69 EAST 59TH STREET, NEW YORK CITY

AMERICAN ROENTGEN RAY SOCIETY MEETINGS

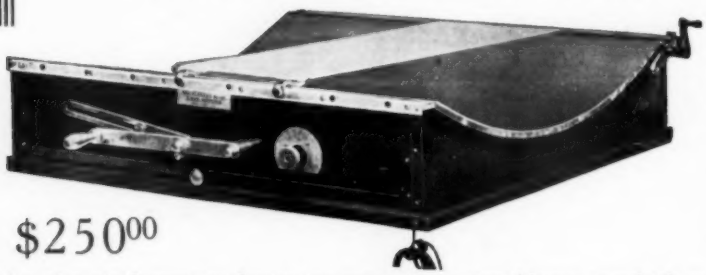
Twenty-Eighth Annual Meeting—TO BE ANNOUNCED

AMERICAN RADIUM SOCIETY

Twelfth Annual Meeting
WASHINGTON, D. C.

Entered as second-class matter, March 3, 1916, at the Post Office, New York, N. Y., under the Act of March 3, 1879.
YEARLY SUBSCRIPTION, $10.00 SINGLE NUMBERS, $1.50

BRADY'S POTTER-BUCKY DIAPHRAGM



$250.00

NEW FEATURES

A new and improved type of grid construction that secures even more brilliant results than our previous grid.

A neat compression band attachment for holding the patient still during exposure.

Patient brought nearer to plate.

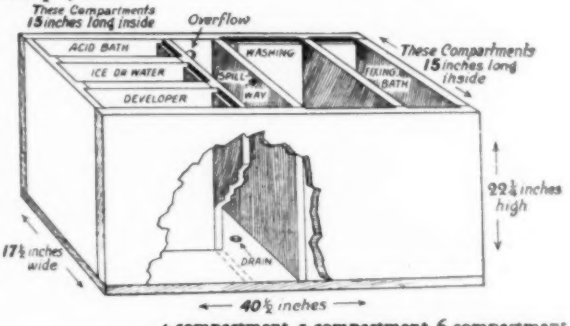
An electrical contact device for operating a signal lamp or which can be connected to most time switches for making the exposure automatically, from 1 to 90 seconds time at $5.00 extra charge.

Our speed control is accurate and reliable and timed in actual seconds. It does not require constant repairs. We claim it is the smallest, neatest and most effective Bucky on the market, 6:1 ratio grid cutting off practically 90% of secondary. Takes all makes of cassettes to 17 x 17 size, operates in horizontal or vertical position, and does Stereoscopic work in either direction.

All-metal construction electrically welded and practically indestructible. They do not get "out of date." Price $250.00 list with cash discount for quick payment.

DEVELOPING TANKS

Our stone tanks are considered the best designs and values on the market. Each has a space for ice or hot water for controlling the developing temperature. The 5 and 6 compartment styles also have a 4" air space to prevent temperature of wash water from affecting the temperature of developer. Lengths over all 24½"-34"-40¼" respectively. Illustration shows our regular 6 compartment style. Special styles to order. We have many sizes of enamel tanks also. Send for special circular.



	4-compartment	5-compartment	6-compartment
Prices shipped from Virginia	$45.00	$53.50	$60.00
Prices shipped from Chicago, Boston or Brooklyn	$50.00	$58.50	$65.00

DR. GRANGER'S SINUS MASK

For radiography of the sphenoid, etc., at 17° angle. We furnish these to fit all standard makes of cassettes. Specify outside size of your cassette when ordering. Made for 8 x 10 only. Price $8.50.

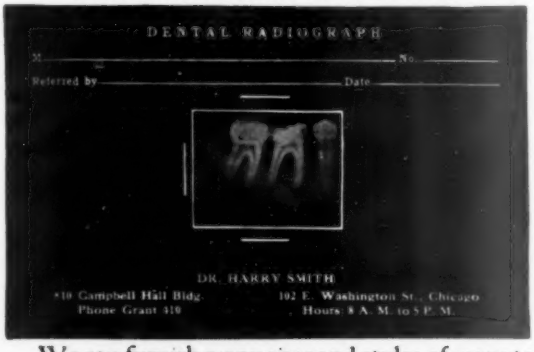
INTENSIFYING SCREENS

Get our net prices on screens either alone, or mounted in cassettes. It may save you some money. We are distributors on Buck X-Ograph cassettes, and carry the standard makes of screens.

BARIUM SULPHATE (Paragon)

We have furnished enormous quantities of this to the profession during the last 10 years. We are prepared to furnish this in prepared form with malted milk or dry milk incorporated at $30.00 per 100 lbs. packed in 25 lb. sealed tin cans. 5 lb. & 10 lb. sizes also available. Price of regular barium $24.00, fluffy style $26.00 per hundred.

DENTAL FILM MOUNTS



We can furnish many sizes and styles of mounts in cardboard or the all-celluloid types. Special designs if desired. Very liberal discounts are allowed on orders for 100 or more. Get our new price list #160—with discounts.

Special on gross lots of #1 size film $6.96.

ASK FOR OUR LATEST PRICE LIST AND DISCOUNTS

GEO. W. BRADY & CO., 761 S. WESTERN AVE., CHICAGO

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XV MAY, 1926 N

A STUDY OF THE HUMAN PLEURA PULMONALIS: ITS RELATION TO THE BLEBS AND BULLAE OF EMPHYSEMA*

BY WILLIAM SNOW MILLER, M.D., SC.D.

University of Wisconsin

MADISON, WISCONSIN

DURING the past year several lungs used in connection with my studies of pulmonary tuberculosis have presented on the mediastinal surface of either the right or left *lobus inferior*, a peculiar wrinkled appearance of the pleura. In one instance the same appearance of the pleura was found in the *incisura* between the *lobus superior* and the *lobus medius* of the right lung, and was connected with the *lobus superior*. These areas had a more or less circular outline, slightly raised above the level of the surrounding pleura, and varied from one to five centimeters in diameter.

The fact that there was no evidence of adhesions, that the wrinkled portion of the pleura was freely movable over the underlying pulmonary substance, and that they did not present the characteristics of a cavity, led to a study of these so-called *blebs*.*

The best description of a bleb, which I have found, is contained in Watson's *Practice of Physic*, that storehouse of information, to which but few turn in these later days, where it is correctly described as a sub-pleural emphysema. He says:

"When it [the air] appears on the surface of the lung, it may be distinguished from the bladder-like prominences which sometimes form there by the dilatation of the air cells, in this way: the bullae which are situated in the areolar tissue connecting the pleura with the lung, may be made to move hither and thither under pressure; whereas those which result from the protrusion of an enlarged cell or cells cannot be made thus to change their place. This sub-pleural effusion of air is sometimes enormous. I have seen it as large as a hen's egg. Bouillaud mentions a case in which the bladder or pouch was equal to the size of a stomach of ordinary dimensions. It proceeds, I presume, from the rupture of a superficial air vesicle."

The migration, under pressure, of the air contained in a bleb is, however, generally restricted by the unruptured septa which pass from the pleura into the lung.

In previous studies the blood vessels and the lymph vessels of the *pleura pulmonalis* have received special attention. In the present study, because of their relation to the condition of the pleura described above, the elastic fibers will be considered in detail.

The pleura pulmonalis is described in many textbooks as a serous membrane, covered by a layer of mesothelium, which rests on a subserous layer of connective

* The terms *bleb* and *bulla* are often used synonymously. In the following account a distinction, which is explained in the text, is made between the two.

* Aided by a grant from the National Tuberculosis Association.

tissue that is composed of collagenous fibers and a few elastic fibers. Within this subserous layer, the blood vessels, lymph vessels, and nerves are to be found.

Of the more specific descriptions of the elastic fibers in the human pleura pulmonalis, that by Linser, and that by Letulle, are deserving of special attention; the

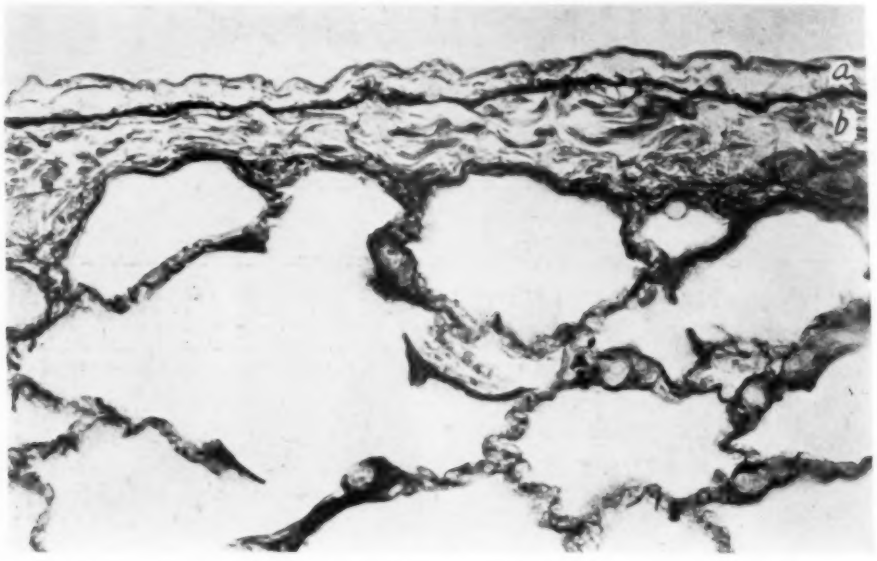


FIG. 1. Normal pleura pulmonalis from the human lung. Selective staining of the elastic fibers. *a*. submesothelial layer; *b*. areolar layer. The elastic layer is the layer of compact fibers between *a* and *b*. (×200.)

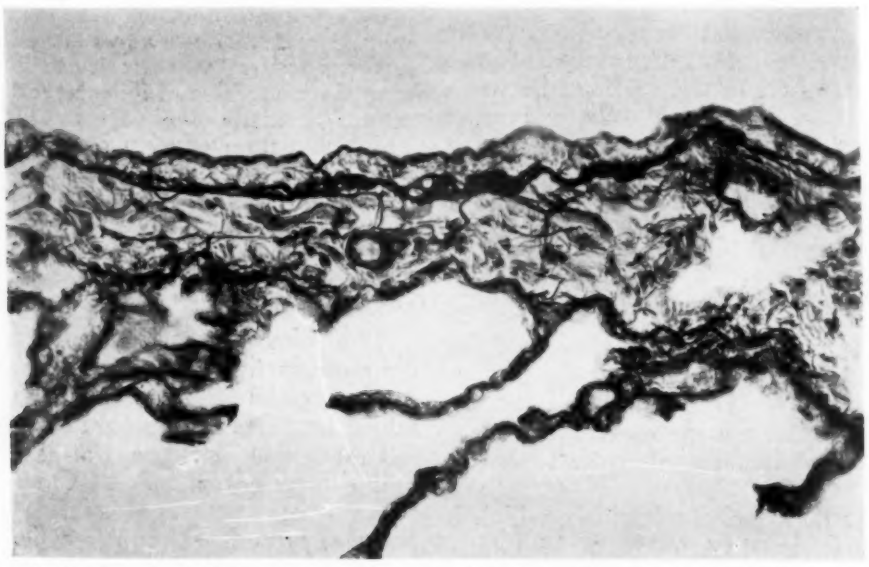


FIG. 2. Normal pleura pulmonalis from the human lung. Selective staining of the elastic fibers. Note that some of the anastomosing fibers which leave the elastic layer, and pass into the areolar layer, have a perpendicular direction. This is especially noticeable just above the radicle of the pulmonary vein in the center of the photomicrograph. In some sections the perpendicular fibers are present in greater numbers and extend from the elastic layer to the network of elastic fibers in the walls of the alveoli. They serve to tie the pleura and the lung more closely together. (×200.)

former, is given from the normal; the latter, from the pathological standpoint.

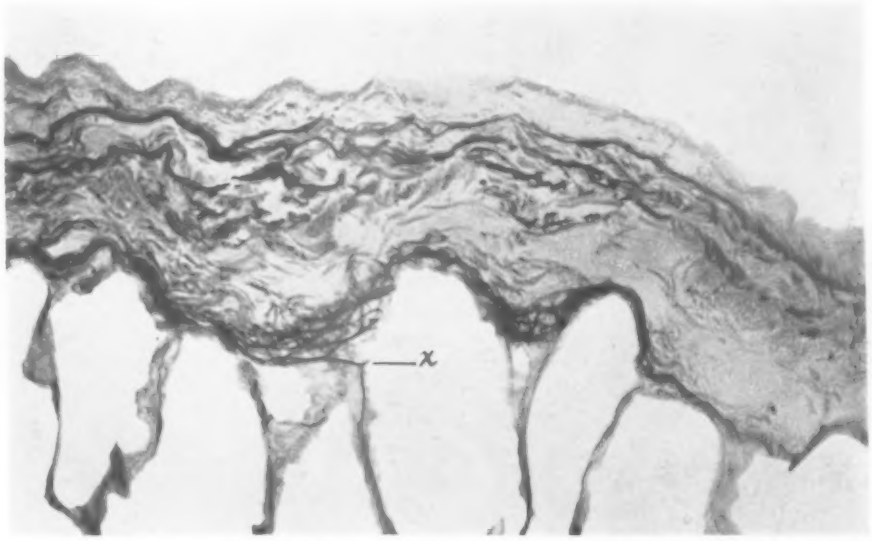


FIG. 3. Pleura pulmonalis from an imperfectly distended human lung. Selective staining of the elastic fibers. Note the loose arrangement of the elastic layer and the presence of bundles of collagenous fibers within the elastic layer. Due to the imperfect distention of the lung, the walls of the alveoli in the central portion of the photomicrograph are cut obliquely, thus bringing into view the network of elastic fibers in that portion of their walls which abuts upon the pleura. At *x*, an anastomosing elastic fiber within the alevolar wall can be seen joining the subpleural network. (×200.)

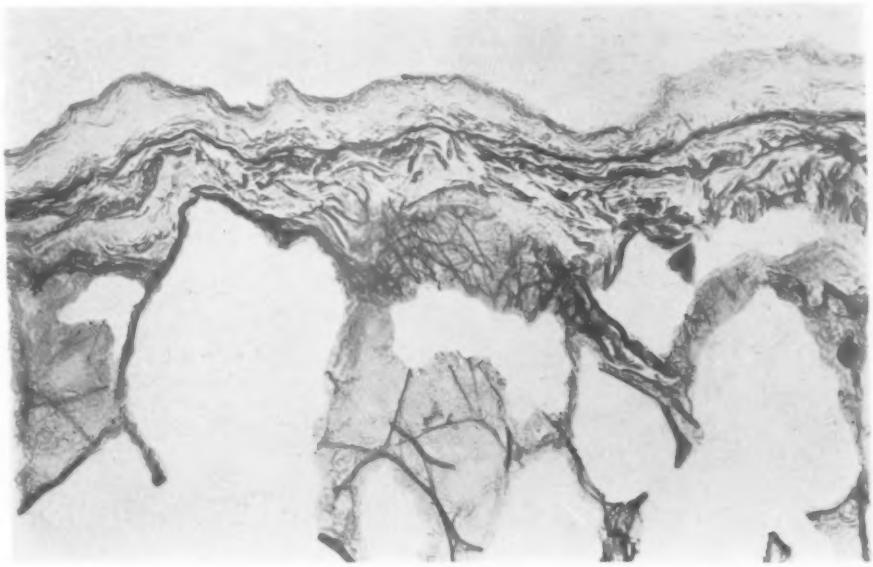


FIG. 4. Pleura pulmonalis from an imperfectly distended human lung. Selective staining of the elastic fibers. This section was cut in such a plane that the network of elastic fibers in the wall of the alveolus in the center of the photomicrograph shows clearly. Immediately below this subpleural network of elastic fibers, the elastic fibers in the walls of the adjoining alveoli can be seen. (×200.)

Linser describes an elastic layer, situated immediately beneath the pleural epithelium (mesothelium), that is made up of fibers which cross one another at an acute angle. This is followed by a layer of connective tissue in which bundles of collagen-

ous fibers are interspersed with fine elastic fibers. Still deeper in the pleura there is a second layer of elastic fibers which runs parallel to the surface of the lung, the individual fibers of which anastomose with the elastic fibers in the walls of the alveoli.

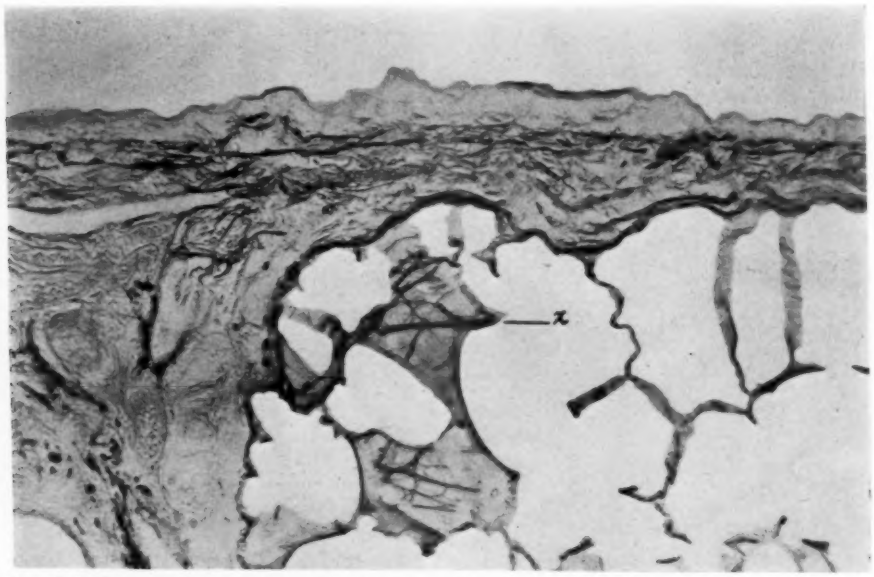


FIG. 5. Section of the human pleura pulmonalis showing on left side of the photomicrograph a septum passing into the lung. Selective staining of the elastic fibers. Note the continuance of the network of elastic fibers in the walls of the alveoli beneath the areolar layer of the pleura with that in the alveoli immediately beneath the septum. At *x*, the network of elastic fibers in the wall of the alveoli, which do *not* come in contact with the pleura, is seen to be the same as that in the alveolar walls which *do* come in contact with the pleura. Compare with Figures 3 and 4. (×200.)

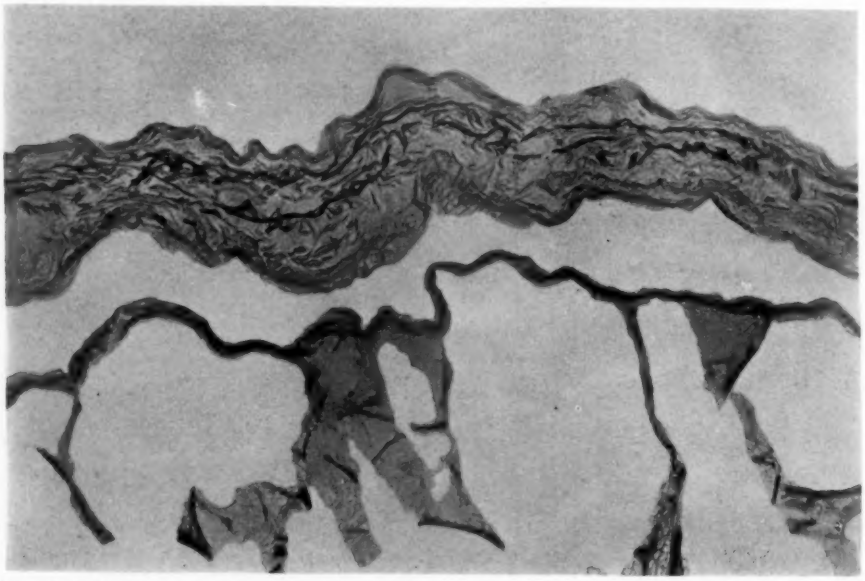


FIG. 6. Section of the human pleura pulmonalis which shows an early stage in the formation of a bleb due to the separation of the pleura proper from the alveoli situated immediately beneath it. Selective staining of the elastic fibers. Note the line of cleavage, and that the network of elastic fibers in the walls of the alveoli is intact. The point at which the air escaped into the pleura does not appear in this section. (×200.)

The description given by Letulle is, in general, more accurate than that by Lin-

ser. Letulle finds that there is on the outer surface of the pleura pulmonalis a layer of flattened endothelial (mesothelial) cells, which rest on an avascular, sub-endothelial layer of connective tissue. Beneath this layer there is a *limitante élastique externa* or *superficielle*, which is comparable to the *elastica interna* of the blood vessels; this forms a part of his *conjonctivo-vasculaire* membrane of the pleura, within which there are numerous blood vessels and lymph vessels. Still deeper in the pleura there is a *limitante élastique profonde* or *externa*, which is reinforced by fibers from the adjacent pulmonary alveoli.

Elsewhere, I have briefly called attention to the fact that this deeper layer of elastic fibers, the *limitante élastique profonde* of Letulle, is not to be considered a part of the pleura; *it belongs to the walls of the subjacent alveoli.*

The surface of the pleura is, as both Linser and Letulle have said, covered by a layer of thin, flattened, mesothelium which, as stated by Letulle, rests on an avascular layer of connective tissue. This sub-mesothelial layer is made up of collagenous fibers that, in some instances, are interspersed with delicate elastic fibers which are derived from the underlying elastic layer, and a network of reticulum that is especially well developed just beneath the layer of mesothelial cells, forming its basement membrane.

The elastic layer is made up, almost exclusively, of elastic fibers. Bundles of collagenous fibers pass through the mesh of the elastic fibers, and a limited amount of reticulum can be demonstrated. A few fine fibers are given off into the sub-mesothelial layer, and anastomosing fibers pass through the areolar layer to join the network of elastic fibers in the walls of the alveoli which abut upon the pleura, and also to join the elastic fibers within the areolar layer. When the lung is distended the elastic layer appears as a compact layer (Figs. 1 and 2); but when the lung is imperfectly distended, the elastic layer often appears as though it were made up of two portions, between which bundles of collagenous fibers may be seen (Fig. 3).

Neither Linser, Favaro, nor Letulle, considers the elastic layer as a separate layer. Both Linser and Letulle consider it as a part of the areolar layer of the pleura—the *conjonctivo-vasculaire* layer of Letulle. Favaro associates it with the sub-mesothelial layer, and calls the combined layers, the *ipopleura*. In some animals, for example the horse, the elastic layer is of such thickness that it is possible to dissect it off as a separate lamina.

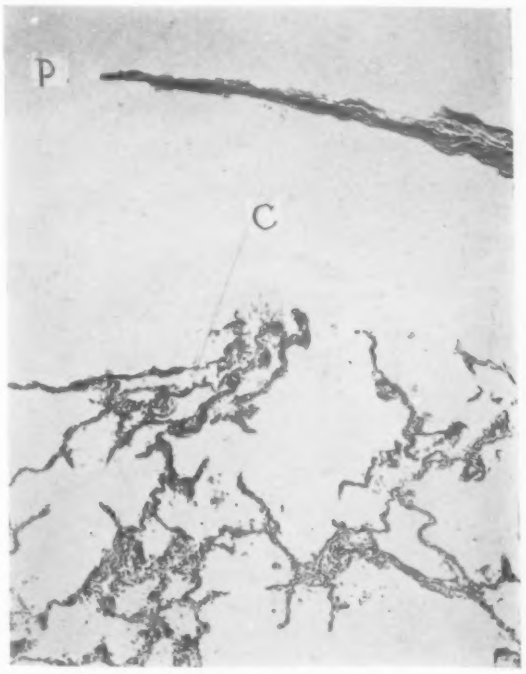


FIG. 7. Section through a portion of a well-developed bleb, showing the ruptured alveoli, and the attenuated pleura which forms its outer wall. On the left of the photomicrograph the intact walls of the alveoli which form the inner boundary of the bleb, can be seen. The pouting of the ruptured alveolar walls is well shown. P. pleura; C. cavity of the bleb. (×50.)

The most important layer in the human pleura pulmonalis is the areolar layer, for within it the blood vessels, lymph vessels, and nerves are situated. This layer is made up of bundles of collagenous fibers between which elastic fibers pass that anastomose, on the one hand, with the elastic layer and, on the other hand, with the network of elastic fibers in the walls of the underlying pulmonary alveoli. The arrangement of these anastomosing fibers is of interest; some of them have a direc-

tion perpendicular to the surface of the pleura (Fig. 2), while others pass obliquely through the areolar layer.

The interesting question now arises: Is the *limitante élastique profonde* of Letulle to be considered a part of the pleura, or does it belong to the underlying alveolar walls? The opinion has already been expressed that it belongs to the alveolar walls.

FIG. 8. Transverse section through a small bulla, situated along the anterior margin of the lower lobe of the right lung. From a case of emphysema. Note that the pleura over the bulla is intact, and that the dilated blood vessels in the pleura can be seen; also the remains of the connective tissue septa. (×5.)

If the wall of an alveolus which is situated directly beneath the pleura be cut transversely, a selective stain for elastic fibers will show a thin line of elastic fibers within the alveolar wall, which may present a slightly beaded appearance due to the sectioning of anastomosing branches (Figs. 1, 2, 3, 4).

When an alveolus is cut in such a manner that the elastic fibers in its lateral walls appear in the section, they can be seen to join the network of elastic fibers in that portion of the alveolar wall which abuts upon the pleura (Fig. 3, *x*).

If a subpleural alveolus be cut in such a plane that the network of elastic fibers in the wall which abuts upon the areolar layer of the pleura comes clearly into view (Fig. 4), it will be seen that it corresponds to the network in the alveolar walls which do not abut upon the pleura (Fig. 5, *x*).

If a section be cut so that it includes a septum, and if the walls of the alveoli adjacent to the pleura and to the septum be at the same time cut transversely, it will be seen that the network of elastic fibers in the alveolar walls beneath the areolar layer of the pleura is continued into the walls of the alveoli which are situated immediately beneath the septum (Fig. 5). The elastic fibers in the alveolar walls which abut upon a septum are not considered a part of the septum; such being the case, why should the elastic network in the alveoli which abut upon the pleura be considered a part of the pleura?

Neither the statement by Linser that there is a second layer of elastic fibers which runs parallel to the surface of the lung, and gives off fibers which anastomose with those in the alveolar walls, nor that by Letulle that the *limitante élastique profonde* is reinforced by fibers from the subjacent alveoli, seems to describe the actual relationship. It is true that anastomosing branches connect the network of elastic fibers in the walls of the alveoli with those in the areolar layer, and also with the fibers in the elastic layer. These anastomosing fibers have a very definite purpose; they serve to tie the pleura proper to the walls of the alveoli and, at the same time, to assist in respiration. It is also quite probable that the elastic fibers within the areolar layer of the pleura have a similar action to those within the pulmonary walls; since, due to the continuance of the elastic fibers of the blood vessels and of the lymph vessels with these fibers, they must exert an influence on the circulation of the blood and lymph.

It has been shown that in the normal pleura, anastomosing fibers extend between the network of elastic fibers in the walls of the alveoli and the elastic fibers within the areolar and elastic layers of the pleura. In the case of a bleb, however, there has been a rupture of these anastomosing fibers, and the pleura proper has been separated from the walls of the underlying alveoli (Fig. 6).

What has caused this separation? In every case that I have had an opportunity to study, blebs have been associated with

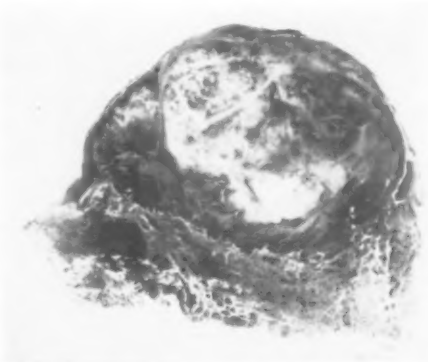


FIG. 9. A large emphysematous bulla which has been formed by the distention, atrophy, and rupture of adjoining alveolar walls, divided through its center. Gross preparation. From a case of pneumonoconiosis in a coal miner. Natural size. This figure, and the preceding one, are from material furnished me by my colleague, Dr. C. H. Bunting.

a well-marked emphysema. The manner in which a bleb is formed resembles that, if indeed it be not the same, which takes place in an interstitial emphysema, namely, a rupture of the wall of an alveolus which allows the air to escape, in this instance, into the areolar layer of the pleura (Fig. 7). This occurs at a point where, from some cause, the elastic fibers in the alveolar wall have given way; possibly from having been stretched to the breaking point.

The air having gained admission into the areolar layer, and having caused it to separate from the walls of the underlying alveoli, extends along the pleura in the same manner that a dissecting aneurysm extends along the wall of an artery. Its extension may be arrested where the septa, which mark out a secondary lobule, join the pleura; it may extend over a number of secondary lobules, or it may be still more extensive, as described by Watson.

The only complete necropsy report that I have of a case in which a bleb was present, was that which accompanied a specimen sent me by Dr. Kennon Dunham, of Cincinnati. This is of special interest in that it brings out certain features of these cases in an interesting manner.

L. L., male; white; aged fifty-six. Advanced tuberculosis. Wassermann negative. Sputum

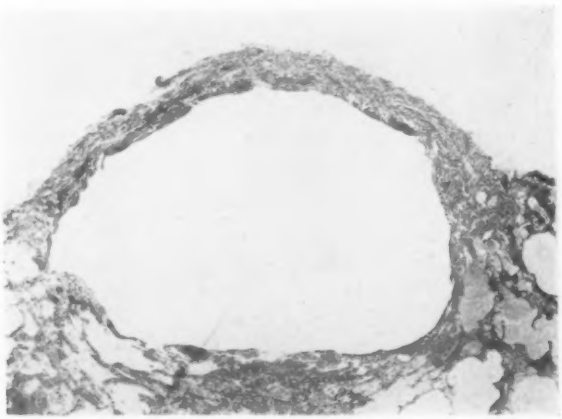


FIG. 10. A small emphysematous bulla, situated at the left of the dilated alveoli shown in Figure 11. (×20.)

positive. [While all my cases of blebs of the pleura have occurred in *advanced* tuberculosis, they may occur in other than tuberculous lungs.] The left lung on its mesial aspect, from a point about two inches posterior to the level of the hilum, and a short distance below the upper margin of the lower lobe, presented a large bleb. This extended about 3 inches down from the above mentioned landmark, and was about 2 inches wide at its widest portion. On opening this bleb, it was found that the visceral pleura could be stripped from the lung so as to make the bleb larger without tearing the subjacent lung tissue. [Probably the bleb extended farther than the external appearances indicated.] At first it was thought that this air containing pocket was visualized in the post mortem lung plates. It was found, however, that the anatomical position of this apparent abnormality did not coincide with its location on the roentgen plates. [This is not surprising; for the above statement that the pleura could be stripped off from the lung *beyond the apparent boundary of the bleb*, shows that the air remaining in the bleb could readily change its position.] In the roentgenograms the lung tissue throughout the posterior and

mediastinal margin appeared emphysematous. [I have found emphysema present in every case where a bleb could be demonstrated.]

The right lung to a lesser extent presents the same looseness of the visceral pleura over the posterior mediastinal surface of the lower lobe.

The bullae which are so frequently found in cases of emphysema along the margins of the lung (Fig. 8) must not be mistaken for blebs. In the case of a bulla the alveoli are first dilated (Fig. 11);

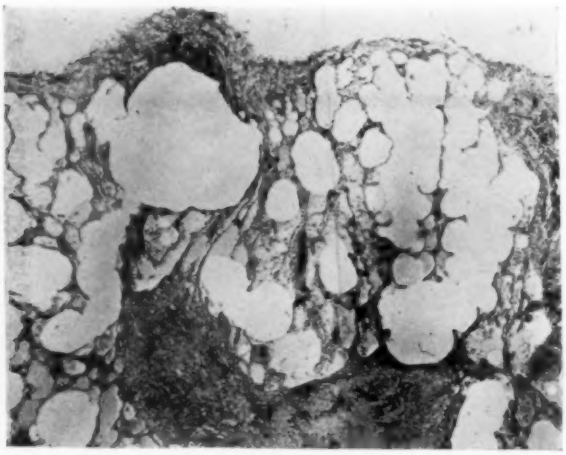


FIG. 11. A section through the emphysematous bulla shown in Figure 10, taken 300 micra below the plane of that section, showing its connection with a bronchiolus. (×20.)

The old tuberculous scar seen in the lower central portion of the photomicrograph, has occasioned the compensatory emphysema with its dilated alveoli and atrophied walls shown on the right. On the left, a bulla (see also Fig. 10) is seen which has been formed by the atrophy and destruction of the alevolar walls in an area similar to that on the right of the photomicrograph.

Query: If the plane of section had passed through the center of a similar, but larger bulla, to that shown in Figures 10 and 11, might not the bulla give rise, in a roentgenogram, to the so-called "balloon" described by some authors?

then atrophy and rupture of the alveolar walls take place, and there is gradually formed a bulla of greater (Fig. 9), or less size (Fig. 10), which communicates with a bronchiolus or a larger division of the bronchial tree (Fig. 11).

The pleura is affected differently in these two types of emphysema. In the first type, an interstitial emphysema has separated it from the underlying alveolar walls and given rise to a bleb, whose outer wall is formed by the attenuated pleura. In the second type, the pleura retains its connection with the lung, although the alveoli beneath it may become greatly distended and eventually, by their fusion, give rise to a *bulla* which projects beyond the level of the surrounding pleura (Fig. 10).

Grossly, in the first type, the pleura gives the sensation of a thin membrane which slides freely over the surface of the underlying lung substance; in the case of a bulla, it is not movable, and the underlying space gives the impression of an air-filled cavity.

During life, the cavity of a bleb is filled with air. The negative pressure within the thorax causes it to project beyond the level of the surrounding pleura. With the cessation of respiration, there is no longer an influx of air to keep the thin-walled space distended, and when the thorax is opened at a necropsy, the negative pressure becomes a positive pressure, and the bleb is practically emptied of its air, giving rise to the wrinkling of the pleura which has been described. On the other hand, in what I have termed the second type of emphysema, though it is the more common type, there is not the collapse that is seen in the case of a bleb.

It has not been my fortune to see, except on the printed page, what are termed by roentgenologists as "annular shadows." I am wondering if some of them may not be blebs? In like manner I also wonder if some of the "small pneumothoraces" may not, after all, be blebs? These questions can only be answered by the roentgenologist; they are outside of my province.

There is, however, an essential difference between a bleb and a pneumothorax: the entire pleura is perforated in a pneumothorax and the air escapes into the thoracic cavity; while in a bleb, it accumulates in the areolar layer of the pleura.

REFERENCES

FAVARO, G. Contributi allo studio dell'istologia comparata e dell'istogenesi della pleure. *Internat. Monatschr. f. Anat. u. Physiol.*, 1909, xxvi, 301.

LETULLE, M. La tuberculose pleuro-pulmonaire, Paris, 1916, 241, et seq.

LINSER, P. Ueber den Bau und die Entwickelung die elastischen Gewebes in der Lunge. Anatom. Hefte, 1900, 307.

MILLER, W. S. The vascular supply of the pleura pulmonalis. *Am. J. Anat.*, 1907, vii, 389.
MILLER, W. S. The anatomy of the lung. *Ref. Hdbk. Med. Sci.*, 3rd ed., New York, 1916, vi, 82.
MILLER, W. S. Some essential points in the anatomy of the lung. AM. J. ROENTGENOL., 1917, iv, 269.
MILLER, W. S. The lymphatics and the lymph flow in the human lung. *Am. Rev. Tuberc.*, 1919, iii, 193.
WATSON, THOMAS. Principles and Practice of Physic. Revised, with additions, by D. Francis Condie. Philadelphia, 1851, 624.

LUNG ABSCESS FROM THE MEDICAL STANDPOINT*

BY RICHARD A. KERN, M.D.

PHILADELPHIA, PENNSYLVANIA

THAT the internist should be chosen to open a symposium on lung abscess is in a measure justified by the fact that he is usually the first to encounter the problems of diagnosis and treatment. A considerable proportion of lung abscesses follow medical conditions of infectious origin, notably bronchopneumonia. Many of the abscesses following tonsillectomy, occurring, as they often do, a week or more after operation and after the patient has left the care of the laryngologist, first come under the observation of the internist. He is often the first to see the foreign body cases, especially when there is no clear-cut history of foreign body inhalation. In this connection, it is well to remember that a lung abscess occurring soon after tonsillectomy may in reality be a foreign body case. The operation is most often performed in children, and it is an easy matter to dislodge with a mouth gag a loose deciduous tooth which may not be missed, even by the patient, in the midst of his postoperative discomfort.

The diagnosis of lung abscess presents a variable problem. The multiplicity of causes makes it impossible to speak of a typical clinical picture early in the disease, and the symptoms will therefore depend in a measure on the etiology. Post-pneumonic abscess usually develops in this manner: During the second week of a bronchopneumonia the lung signs gradually lessen except in one area where they persist. The appearance of the patient changes; he is less dyspneic but looks more toxic. He sweats profusely and his temperature becomes more widely fluctuating. If the lesion is close to the pleural surface, the signs may suggest fluid, and this in turn with the appearance of the patient may raise the question of empyema. However, cough is more pronounced and often of a peculiarly searching character: the sputum tends to become more and more purulent, often has a sweetish fetid odor, and on standing tends to separate into the well-known three layers. Post-tonsillectomy abscess usually begins with an acute onset of fever, cough and localized pain in the chest and is commonly mistaken for pleurisy or pneumonia. The same is true of the abscesses which follow septic infarction of the lung after operation in an infected field, such as ischiorectal abscess or pelvic inflammatory disease. All cases of long standing, no matter what the cause, look very much alike; there are the evidences of long-continued sepsis together with the unmistakable signs of a lung lesion, usually with excavation. The sudden onset in a patient with a lung abscess of a state of profound shock usually indicates that most serious and usually fatal complication, a rupture of the abscess into the pleura.

The physical signs depend upon the location of the lesion, and therefore vary widely in different cases. If the abscess is close to the pleural surface and the chest wall it will give early and obvious signs, usually those of a patch of localized consolidation. Later there may appear the

* From the Medical Division of the Hospital of the University of Pennsylvania; read before the PHILADELPHIA ROENTGEN RAY SOCIETY, January 7, 1926, in a symposium on "Lung Abscess."

evidences of cavity formation, but here again the signs will depend upon whether the cavity is full or empty, An area that is now flat to percussion and over which fremitus is absent and breath sounds inaudible, suggesting a localized fluid collection, may, in a few minutes, after the expectoration of an ounce or two of sputum, be hyperresonant to percussion, with amphoric breathing and coarse bubbling râles on auscultation. Or, one may hear the "trap-door" breathing or "veiled puff" over a cavity half-filled with pus, and into which air enters with a rush only toward the end of a deep inspiration.

On the other hand, if the lesion is deep-seated, or close to the lung hilum, physical signs may be very slight and hard to elicit. There may be little or no impairment on deep percussion, perhaps a few distant râles on coughing, and a little less expansion on the affected side. In such cases, the diagnosis can at times only be suspected on the basis of the history.

Roentgen-ray examination is, of course, invaluable, not only in the diagnosis, but also in the exact localization of the abscess. And such exact localization is most important, as will be seen from what follows, both in the determination of the type of treatment required as well as to guide the surgeon when operation becomes necessary.

Diagnosis by attempted aspiration, still recommended in some textbooks, is to be condemned. The withdrawal of an infected needle through a clean pleura may add an empyema to the patient's difficulties. Picot has reported 6 such cases, 3 of which resulted fatally.

The diagnosis established, what shall be the treatment of a given case of lung abscess? This is a question to which only a few years ago widely differing answers would have been given by surgeon and internist, and each would have cited statistics to support his views. But statistics have simply shown that a proportion of lung abscesses heals spontaneously, or as the result of non-operative treatment, postural drainage and the like, while the rest improve only up to a certain point, then become chronic, and the patients continue in a state of prolonged hopeless invalidism, from which death is a welcome relief.

Experience has however made it possible for us to predict which course a given case is likely to take, and to say when operation is indicated. The chief differentiating criteria are the following: (1) An abscess in an upper lobe is more apt to have adequate natural drainage, and therefore is less likely to need external drainage than a lower lobe lesion. (2) An abscess situated close to the lung hilum is not only in close relation to large bronchi and therefore likely to drain spontaneously, but is also in an excellent position for bronchoscopic approach. (3) On the other hand, an abscess close to the periphery of the lung is in connection with only small terminal bronchi, can rarely be emptied satisfactorily by postural drainage, and is difficult of access for the bronchoscopist. In such a lesion surgery usually becomes necessary.

It is logical that medical treatment should be the first to be discussed for the very good reason that all cases of lung abscess require it at first, regardless of their subsequent course. A few hyperacute and fulminant cases go rapidly to destruction, and surgery would only precipitate the end. The rest of the cases all tend to improve for a time spontaneously, and the degree and speed of this improvement can be favorably influenced by proper medical management. A patient, who in the early acute stages is usually a poor surgical risk and might promptly succumb to operation, can a few weeks later be turned over to the surgeon without fear of catastrophe. After operation as well as before, the cooperation of the internist is desirable for the best results.

What is the medical treatment of lung abscess? It includes the following:

(1) *Postural Drainage.* The abscess cavity should be emptied several times a day by placing the patient in a suitable position for ten to fifteen minute periods. Just which position is the right one must be determined in each individual case, since it depends wholly on the chance relation that the abscess cavity may bear to the bronchus with which it communicates. For example, while a lower lobe abscess usually drains best when the patient is head-down and on the side opposite that of the lesion, it may actually empty more easily when in the reversed position. Roentgenoscopic

bedside examinations should be useful in this connection.

(2) *Rest.* It is best to keep these patients at rest in bed as long as there is fever as evidence of a general septic state. This is a detail that is not generally emphasized. In fact, many are inclined to get these patients up in a wheel-chair. The only advantage of the latter is easier access to a sun-porch, and in the newer hospitals this can also be done with bed patients.

(3) *Diet.* These patients need a high caloric diet to keep up their nutrition and strength. Yet so often on admission the house doctor puts these patients, suspected of a pneumonia, on a liquid or restricted soft diet and then never thinks of the diet again. Usually they have a good appetite and good assimilative power, in spite of the fact that severe bouts of coughing may at times precipitate vomiting.

(4) *Vaccine.* An autogenous sputum vaccine is worth trying after the acute initial stage with its phenomena of sepsis is past and the lesion is to all intents and purposes a localized one. The cultures are best made from uncontaminated material obtained through the bronchoscope. Just how much good such a vaccine does in any particular case cannot be said, but it is undoubtedly of value, and in a borderline case may be the determining factor in the non-operative cure of a patient.

(5) *Drugs.* Any drugs to be used depend of course upon the indications. Bitter tonics may be needed to stimulate a flagging appetite; iron and arsenic are called for in the secondary anemia which so commonly develops. A common error, to which Dr. Chevalier Jackson has called attention, is the tendency to use cough sedatives to excess and thereby lessen one of the natural means of drainage. They should be used judiciously to insure sleep but should never be given routinely or on "P.R.N." orders to be given at the discretion of a pupil nurse.

(6) *Bronchoscopic Treatment.* This newest and most powerful ally in the management of lung abscess is invaluable, both in diagnosis and treatment.

How long shall one persist in the above measures before resorting to operation? The answer is, not too long. If the patient continues to improve, it is usually safe to wait for from six to eight weeks. At the end of that time, many a case that at first seemed surely to need intervention will be well on the way to non-operative cure.

During this time there should be careful observation of physical signs, checked not less than once a week by roentgen examination. A case that appears from the start to need operation should be seen regularly also by the surgeon during the preliminary medical management, that he may become familiar with his patient. An abscess which has not cleared up at the end of three months is not very likely to do so thereafter without the aid of surgery.

THE ROENTGEN-RAY DIAGNOSIS OF LUNG ABSCESS*

BY HENRY K. PANCOAST, M.D.

University Hospital

PHILADELPHIA, PENNSYLVANIA

THE roentgen-ray examination of a case of lung abscess usually follows, as it should, a careful clinical study of the case, during which the condition is detected as such, becomes suspected, or nothing can be found to account for the symptoms (Fig. 1). The examination is made primarily to confirm the clinical diagnosis, to furnish the additional information needed to establish it, or, occasionally, to present the entire pathological picture necessary to explain the subjective symptomatology or to correct a mistaken clinical opinion as to the condition present. Dependence upon a roentgen-ray examination has increased in recent years because of its necessity in establishing the policy of treatment and in determining the progress of the condition under the therapeutic measures adopted. There is nothing new to offer in the roentgenologic diagnosis of pulmonary abscess, but a discussion of this phase of the subject must always form a connecting link between the discussions of medical diagnosis and treatment.

The interpretation of the roentgen-ray evidence of pulmonary abscess is usually not a difficult matter, and yet the appearance is not always so strikingly characteristic as to present undoubted proof of the condition. There are two very important factors to be considered in diagnosis: (1) A comprehensive clinical knowledge of the case is essential in order that the examination may be carried out properly and the interpretation of roentgen-ray findings made correctly, and (2), suitable and adequate diagnostic methods. Little is to be gained by a haphazard examination. Roentgenoscopy is always advisable when the condition of the patient permits, and it should be made in the erect posture if possible, in order to study diaphragmatic movements, observe fluid levels and locate adventitious shadows in order to place the patient most advantageously for the roentgenographic examination. Diaphragmatic study may play an important part in the diagnosis. Stereoscopic roentgenograms in the erect posture are always essential. Flat, one view, bedside examinations are rarely satisfactory, may be confusing, are usually not dependable either for diagnosis or for localization, and fluid levels are not obtainable. Moreover, the lung fields are reduced because the heart and other mediastinal shadows are relatively large and the diaphragms are high. Direct lateral views in the erect posture are usually essential for determining the extent and location of the lesion (Fig. 3, D). If there is a fluid level, these points can frequently be still more fully determined by having the patient lie on the unaffected side and making a fore and aft view (Fig. 3, C). Finally, serial studies are frequently required for diagnosis because it is necessary to find cavitation which may not appear the first time, or to await the clearing up of an obscuring, delayed pneumonic resolution, an excessive inflammatory zone or an atelectasis (Fig. 3, B). One should always continue to study a case serially until the diagnosis is apparently assured.

The cause of a lung abscess frequently has some bearing on its early roentgenographic appearance, although there is no characteristic appearance assigned to any definite cause. For example, the early appearance of an abscess arising as a late resolving pneumonia is subsiding, will usually be different from a lesion following tonsillectomy, even though the appearances do not differ essentially later on. Moreover, a knowledge of etiology is a part of our knowledge of pathology, which is so essential in all chest roentgen-ray diagnosis.

The causes of pulmonary abscess may be conveniently grouped in the following manner:

1. *Pneumonia*, formerly regarded as a very frequent cause of abscess, is now

* Read before the PHILADELPHIA ROENTGEN RAY SOCIETY, January 7, 1926, in a symposium on "Lung Abscess."

recognized as a comparatively infrequent one. The condition may follow either lobar or bronchopneumonia (Fig. 2).

2. *Blood stream infections*, through the agency of infected emboli, or possibly, non-infected emboli causing infarcts in which infection later takes place. Tonsillectomy is undoubtedly the most frequent source of such emboli (Fig. 3). We have examined more lung abscess cases in which the lesion followed tonsillectomy than those arising from any other single cause. From our own observations, we believe the great majority of post-tonsillectomy abscesses are embolic in origin, because of their greater frequency in upper lobes and their predilection to occur peripherally. It is quite reasonable, however, to suppose that some may arise from inspiratory causes, especially when they are found in the lower lobes. Postpartum infections and abortions are no doubt frequent causes of abscess through septic emboli. We do not, of course, include in our list of causes general multiple abscess formation of pyemia.

3. *Inspiration of septic material* from various sources, especially during operations (Fig. 1), and more particularly those on the mouth and upper respiratory tract. As previously suggested, post-tonsillectomy abscesses may occur from this cause, as well as through blood stream infection, but certainly not so frequently.

4. *Foreign bodies* in the lower air passages are rather frequent causes of lung abscesses, but certainly not so often as was the case before the advent of successful bronchoscopy and the roentgen-ray detection of non-opaque foreign bodies. This cause should always be considered when a lung abscess case is encountered, and a possible foreign body looked for unless the exact cause is fairly certain.

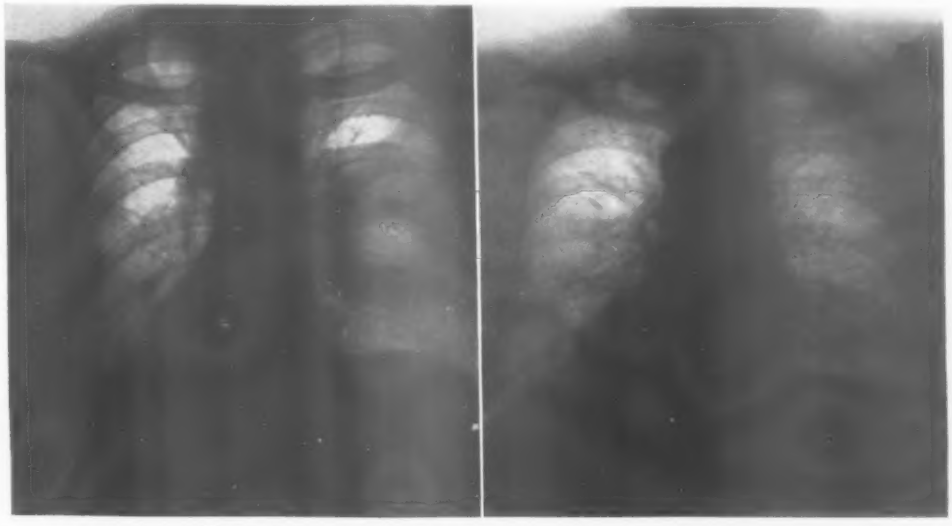


FIG. 1A. FIG. 1B.

FIG. 1. Male aged sixty-six. Operation, suprapubic prostatectomy. Subsequently the temperature rose and the patient developed a very severe cough and foul breath. A. Examination made eighteen days after operation showed a large multilocular abscess in the right lung, containing air and fluid. Absolutely no physical signs could be found in the chest to suggest an abscess, but this diagnosis was accepted. Lack of signs was explained by the central location of the lesion in an emphysematous chest. The condition gave no further trouble and healed under medical treatment alone. B. No evidence of the abscess remained four months later and the patient was perfectly well.

5. *Respiratory infections*, other than pneumonia, are mentioned as one of the causes of lung abscess, but our own experience does not include any cases which could not be accounted for in other ways.

6. *Lymphatic extension* from carcinoma of the esophagus and mediastinal lymph gland infection is also mentioned as a

cause, but we have observed no cases of this kind, although the one shown in Figure 4 might possibly be so regarded.

7. *Carcinoma of the esophagus* with perforation and direct leakage into the interstitial lung tissue is not an infrequent cause, usually producing extensive multiple lung abscess formation (Fig. 4). This avenue of infection is certainly much more frequent than the preceding one.

ROENTGEN-RAY APPEARANCES

An abscess of the lung must present the same essential characteristics as a lesion of the same kind located anywhere else in the soft tissues of the body, except as it is modified by the anatomical structures of the lung. In the beginning, it is an acute inflammatory area which soon breaks down just as we have seen in many superficial abscesses in various parts of the body. Naturally in a lung abscess, the pus must drain somewhere, and the process usually opens up a bronchus for the purpose, unless, unfortunately, it happens to open into the pleura. As a result, we find two essential roentgenologic appearances,—acute consolidation and cavity, with the addition of certain secondary appearances, such as extensive areas of congestion, atelectasis, empyema or pyopneumothorax.

1. Acute consolidation is variable in size and irregular in extent and outline. It may present well out at the periphery (Fig. 5) or be close to and apparently more or less connected with the hilum (Figs. 2 and 4), depending somewhat upon the cause of the lesion. The greatest bulk is almost always peripherally located and may be against the pleural surface (Fig. 5). The consolidation is not characteristic in appearance, and may resemble a pneumonia, tuberculous consolidation, new growth (Figs. 6 and 7), area of atelectasis, uninfected infarct or localized empyema. The distinction will often have to be made solely upon the basis of the clinical aspect of the case, except when bronchoscopy may distinguish between abscess and tumor, a means of differentiation which we have frequently requested and found successful (Fig. 11). After lobar pneumonia, the consolidation may pass through delayed resolution from that of one condition to that of the other, or the pneumonic consolidation may nearly clear up before evidence of the abscess appears. The diagnosis is very frequently inconclusive upon the evidence of consolidation alone.

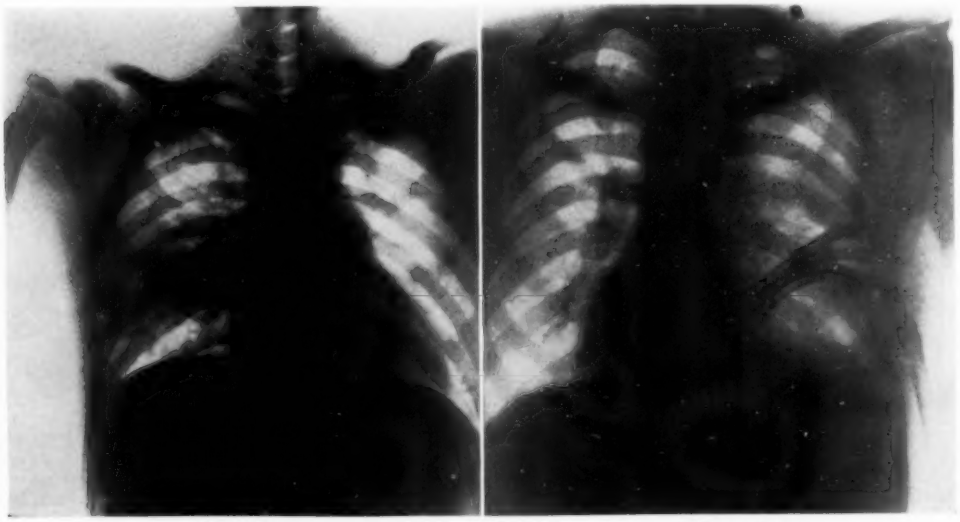


FIG. 2A. FIG. 2B.

FIG. 2. Male, aged twenty-eight. History of cough and expectoration for eighteen months following pneumonia. Had been worse for two weeks, confining him to bed. T.P.R. 101–108–28. A. Roentgen-ray diagnosis on bedside examination, abscess of the right lung, with cavity formation. B. After thoracotomy and during Dakinization.

FIG. 3A.

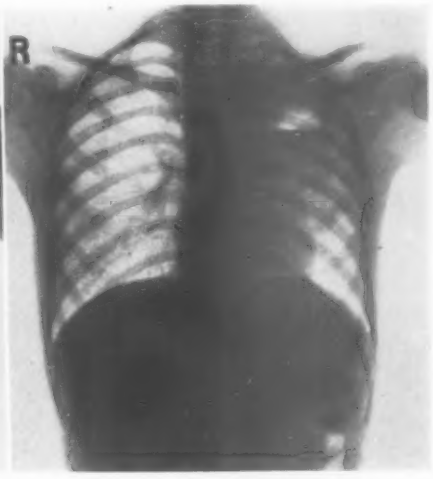


FIG. 3B.

FIG. 3C.

FIG. 3D.

FIG. 3E.

FIG. 3. Male, aged nine. Tonsillectomy four weeks before. A. Roentgen-ray diagnosis, abscess of left upper lobe, based upon consolidation and cavity with fluid level, but with a possibility of a localized or interlobar empyema in addition. B. Appearance the following day more definitely that of abscess, surrounded by a wide zone of congestion or possibly some atelectasis in addition. C. Patient lying on right side. D. Lateral view, patient erect. E. Three weeks later, after bronchoscopic drainage, the evidence of the abscess has largely disappeared, leaving only some slight increase in density.

2. Cavity formation is the second essential characteristic feature of pulmonary abscess. This is, of course, not seen at the very beginning of abscess formation, and when there is doubt as to the diagnosis the patient should be examined repeatedly, and daily if necessary, until the cavity appears. It may be entirely empty of fluid or may contain pus and air, in which case there will be a fluid level, and under such circumstances it is wise to examine the patient in three planes in order to better determine the size and extent of the cavity (Fig. 3). A cavity may be present but filled with pus, and not show, hence its appearance may be hastened by bronchoscopic drainage. The cavity seen may be only one of many, the others not draining, and the extent of the abscess will have to be estimated by the extent of the area of consolidation. Drainage from a cavity may cease after the clear area has been once demonstrated.

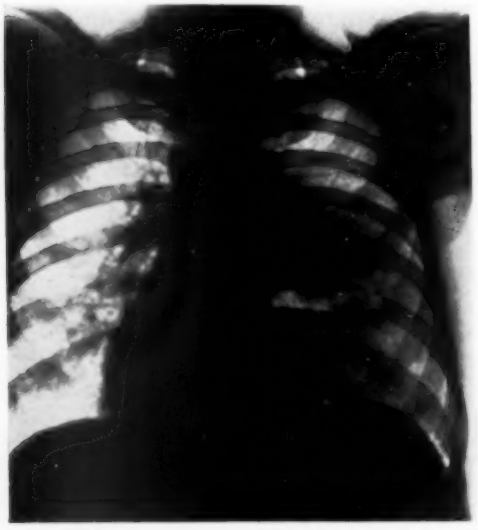


FIG. 4. Male, aged thirty-nine. Abscess of the right lung, with multiple cavitation accompanying a carcinoma of the midthoracic esophagus, with almost impermeable stricture. A satisfactory roentgenogram of the esophagus was not obtained because the patient could not retain liquids. A capsule located the obstruction. An esophageal fistula was not demonstrated. The patient had a gastrostomy.

3. A very extensive zone of congestion around an abscess area may simulate consolidation and give the impression that the consolidation is much more extensive than it really is. Such a zone is likely to subside rapidly and one may be led to believe that the abscess is resolving with equal rapidity. The entire area of abscess and congestion may simulate a pneumonia when the abscess is due to some other

FIG. 5A. FIG. 5B.

FIG. 5. Female, aged forty-four. Had tonsillectomy one month before. A. Lesion at the right base showing consolidation and fluid level in a cavity. The appearance is that of an abscess. It is against the pleura and evidently a case for operation and not bronchoscopic drainage. The elevation and fixation of the diaphragm (by roentgenoscope) indicate probable localized pleural involvement and adhesions, which is favorable for operation. At operation by Dr. Müller, the two pleural surfaces were found adherent and no first stage operation was required. B. Lateral view, still further localizing the lesion for operation.

cause. Likewise, an area of atelectasis may surround the abscess and present similar difficulties in interpretation.

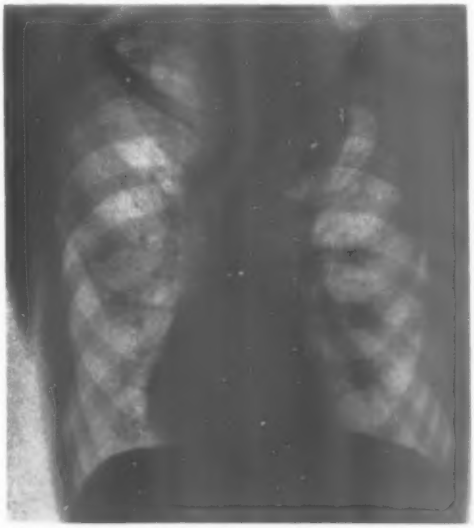


FIG. 6. Male, aged sixty-six. Right apical chest tumor without bone erosion and probably a primary lung carcinoma. The lesion produced the characteristic shoulder pain of growths in this locality. There was no sympathetic involvement. Abscess and localized empyema cannot be absolutely excluded. Tapping is not advisable in such a case if abscess is at all likely, because of the danger of infecting the pleural cavity.

SUBSEQUENT COURSE AND TERMINATIONS

It is now customary to continue roentgenologic studies of lung abscess cases during the progress of any method of treatment. We have learned by experience that certain definite changes may take place which we can readily detect, whether they be signs of regression or of progression or untoward results.

1. *Rupture into a Bronchus.* This is recognized by the appearance of cavity, and is the most fortunate and convenient occurrence from the standpoint of diagnosis. The emptying of the cavity may be assisted by bronchoscopic drainage. If discharge has taken place spontaneously, it may be of assistance to the bronchoscopist for us to determine which bronchus is draining the cavity. This is by no means possible in most instances.

2. *Resolution or drainage* under bronchoscopy or operation is best studied roentgenologically.

3. *Spontaneous recovery* has been one of the terminations mentioned by various writers, but we take exception to this, and believe that we should more properly and with more respect employ the term "regression under medical treatment,"

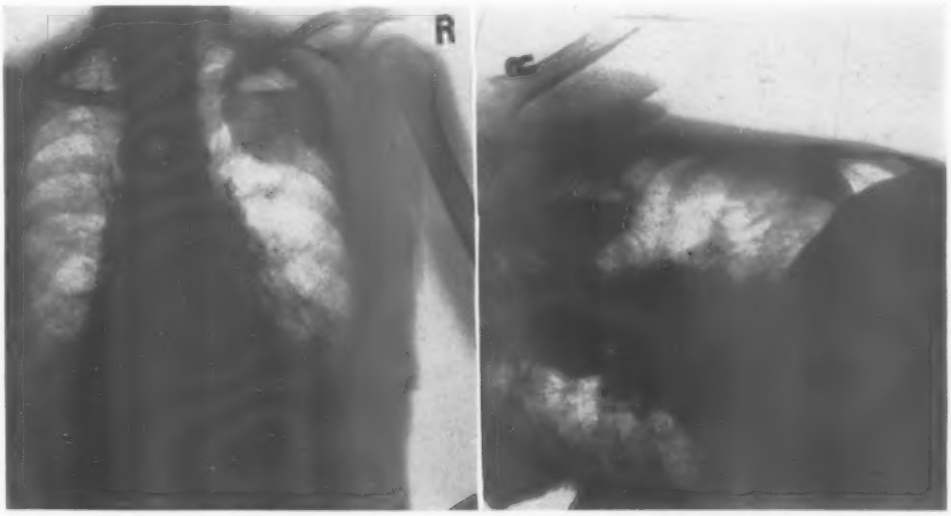


FIG. 7A. FIG. 7B.

FIG. 7. Female, aged seventy-five. For six months the patient had suffered intense, continuous pain in the right shoulder and arm. The examination was made for a possible cervical rib or apical chest tumor. We found a lesion resembling the growth shown in Figure 6, except that it showed a fluid level, indicating an abscess, or possibly a localized pyopneumothorax. Worry over the differential diagnosis of apical chest tumor was not necessary with the fluid level in evidence. B. Change in fluid level with patient lying on her left side. This patient was operated upon by Dr. Müller and an abscess found and drained. Cause not known.

for the reason that the internist is largely responsible for this termination (Figs. 1 and 8). Medical care implies postural drainage.

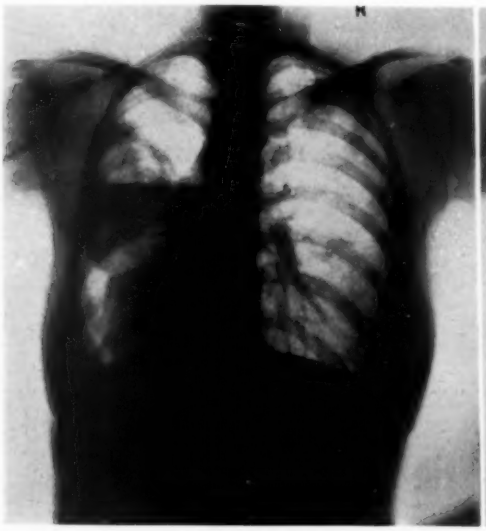


FIG. 8A.

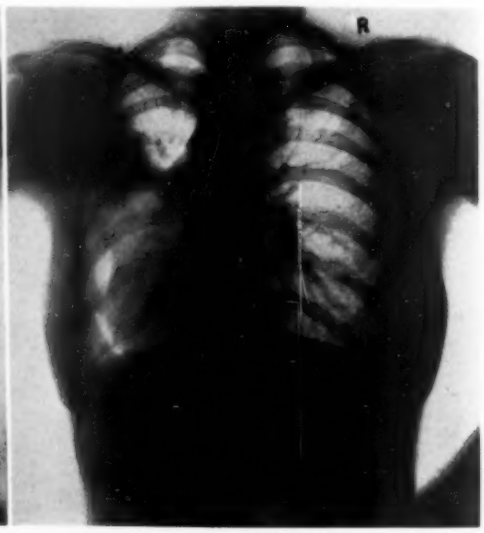


FIG. 8B.

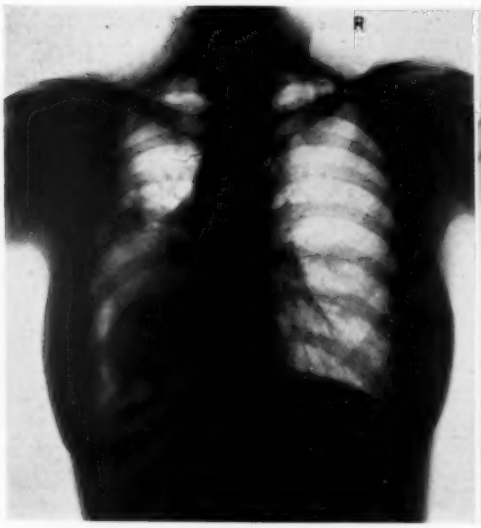


FIG. 8C.

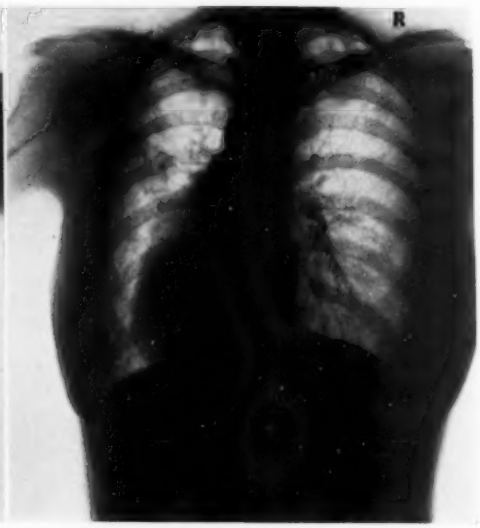


FIG. 8D.

FIG. 8. Female, aged twenty-two. Had influenza-pneumonia with consolidation of the left upper lobe and base. The signs cleared up a week ago except dullness below the clavicle and distant voice and breath sounds. A. Consolidation with cavity and fluid level probably left upper lobe, due to lung abscess or pyopneumothorax. As there had been no paracentesis to introduce air, the lesion was regarded as an abscess. B. Thirteen days later, on medical treatment. The lesion is less extensive and presents more the appearance of abscess. C. After one month, the cavity is very small and the lesion is fibrosing. D. After seven months, the patient is entirely well and very little cicatrization is shown.

4. *Rupture into the Pleural Cavity*. This is a very dangerous accident, and in no case we have examined in which rupture took place into the open pleural cavity has the patient recovered. The rupture is usually accompanied by a sudden collapse of the patient, and should this be observed at any time, it should be a warning for an immediate roentgen examination (Fig.

9). One should be especially watchful if the abscess is located well against the pleural surface of the lung. The consolidated area may, of course, become well walled off by pleural reaction and adhesions so that rupture into the general cavity is not likely to occur (Fig. 5). If the abscess is near the base, pleural involvement with the formation of adhesions may be suggested by the effect upon diaphragmatic movement (Fig. 5).

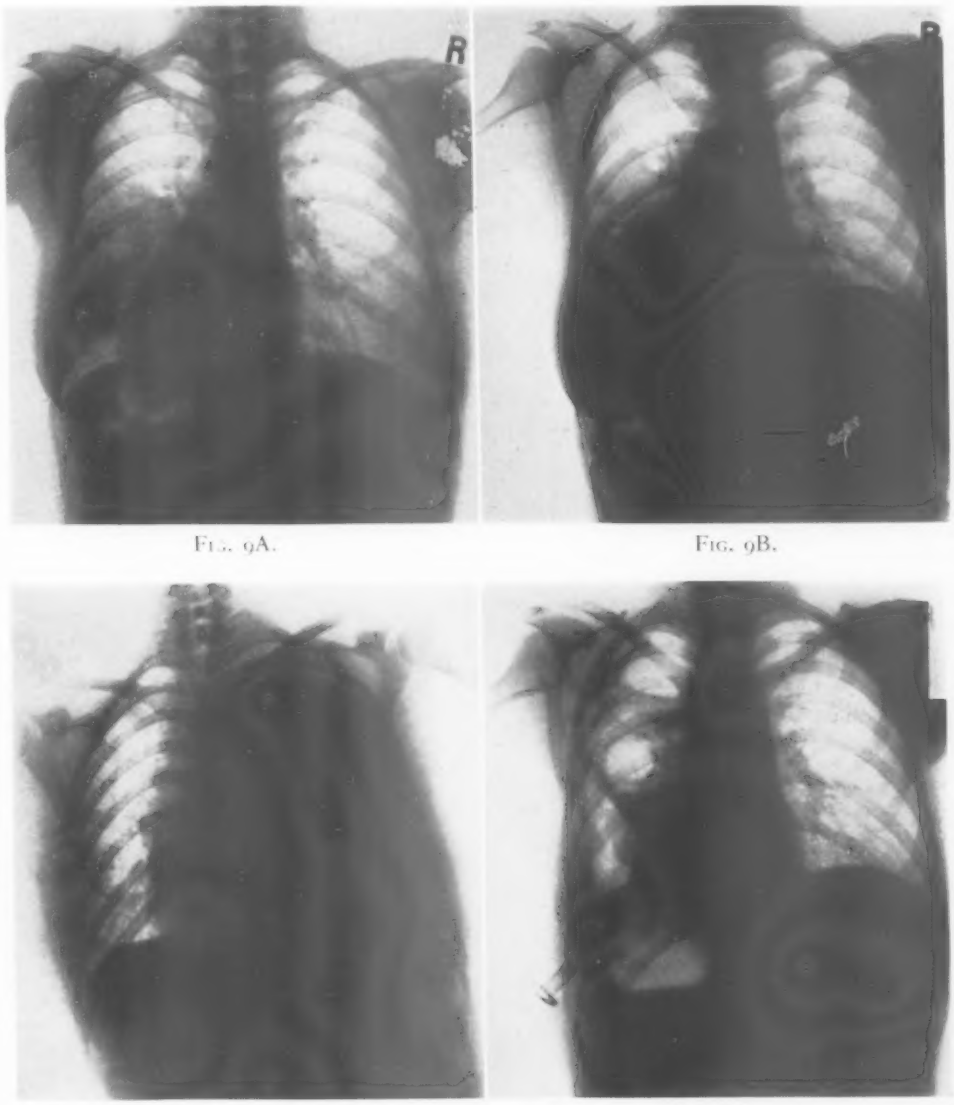


FIG. 9A. FIG. 9B.

FIG. 9C. FIG. 9D.

FIG. 9. Female, aged twenty-two. Present illness dated immediately after tonsillectomy six months before. A lung abscess had been diagnosed previously, and the patient was sent to Dr. Jackson for bronchoscopic drainage. Our first examination, A, showed a lesion involving a large part of the left lower lobe and a suspicion of multiple cavitation. B. Six days later, multiple cavitation is more noticeable. C. Bedside examination six days later, following rather sudden collapse of the patient, shows the left pleural cavity containing fluid. As the patient was recumbent, air could not be detected. Rupture into the pleural cavity was very evident. This was confirmed by immediate operation. A large amount of foul pus was evacuated. D. The condition three weeks later. A large draining abscess cavity is seen, together with the draining pyopneumothorax cavity. Other abscesses subsequently ruptured into the pleural cavity and the patient ultimately died.

5. The condition may terminate in multiple abscess formation and chronic interstitial pulmonitis (Fig. 10), possibly followed by bronchiectasis.

In conclusion, the roentgen-ray examination is the most important method of studying lung abscess, for the following reasons:

1. *Diagnosis of the Condition.* It is the most exact single method, but its accuracy depends upon a thorough knowledge of the clinical aspect of the case, and the final diagnosis should be made only after correlation of the roentgen-ray findings and the clinical data.

FIG. 10. Female, aged twenty-three. Lung abscess followed influenza five years before. Had artificial pneumothorax several times. Sent to Dr. Jackson for bronchoscopic drainage, but the futility of such a procedure is realized by observation of the condition of extensive multiple lung abscess and chronic pulmonitis of the right lung as shown by the roentgen examination. Some pneumothorax still persists at the apex.

2. *Location and Extent of the Abscess.* This must, in many instances, be the determining factor in the choice of the method of treatment. It is conceded, of course, that practically all cases are medical in the beginning, and continue so unless they show little or no improvement for a period of a few weeks. Then location and extent will determine whether bronchoscopic drainage or operation is indicated. An upper lobe lesion, one located peripherally against the pleural surface (Fig. 5) and extensive multiple abscess formation (Fig. 10) are not regarded as suitable cases, as a rule, for continuance of this method, but are surgical by preference. Accurate localization is, of course, necessary for surgical intervention.

FIG. 11. Male, aged fifty. Patient referred to Dr. Jackson for bronchoscopy for possible foreign body and abscess of right lower lobe. It was thought that one of the opaque shadows due to calcified glands might be a tooth, but we thought not. The possibility of an ulcerating broncholith causing bleeding was considered. The final roentgen diagnosis was probable abscess of the right lower lobe, although gumma and new growth could not be eliminated. Bronchoscopic examination showed primary carcinoma.

3. *Study of the progess* under treatment, efficiency of medical, surgical or bronchoscopic procedures and the detection of rupture into the pleural cavity are further advantages of the roentgen-ray examination.

BRONCHOSCOPIC TREATMENT OF LUNG ABSCESS*

BY GABRIEL TUCKER, M.D.

PHILADELPHIA, PENNSYLVANIA

IN suppurative disease of the lung bronchoscopy is first, a valuable means of diagnosis. The first bronchoscopy in any case is essentially a diagnostic bronchoscopy. It will give information as to the location of the lesion, the particular part of the lung and lobe involved, and by determining the amount and character of the pus and the local condition of the bronchi in the affected area, an idea of the severity of the process can be obtained. Uncontaminated cultures can be taken from the suppurating area and the bacteria identified. The differential diagnosis between tuberculous and non-tuberculous suppuration may be aided. Neoplasm of the trachea or bronchi can be determined by the bronchoscopic removal of tissue for histologic examination. The presence of dilatations, strictured bronchi, deformity of the bronchial lumen, deviation and fixation of the bronchi, and abnormalities of the bronchial movements can be definitely determined, and may be of value in making the correct diagnosis in the case under consideration. In most cases of pulmonary disease the roentgenologist by the study of the stereoscopic films is able to give a marvelously accurate opinion of the lesions in the lung. In a certain class of cases the bronchoscopic insufflation of an opaque substance, such as bismuth subcarbonate, as first carried out by Chevalier Jackson, will be a great aid to the roentgenologist in stereoscopic study. A pneumonogram thus produced is welcomed by the surgeon and the internist in certain cases as the greatest aid since the development of diagnostic roentgenology itself. In some cases a liquid opaque substance is to be preferred for pneumonography. In such cases the use of lipiodol recently developed by French chemists has proved ideal. It is not irritating and is quite opaque. We quite agree with Ballon, who has used lipiodol in a long series of cases, that the introduction of this substance bronchoscopically is very much more accurately localized than by intratracheal methods. The bronchoscope can be introduced to the area of the lung that it is desired to roentgenograph and only this portion of lung need be prepared with the radiopaque substance. By pneumonography the presence of cavities, bronchial dilatations and strictures, and the relation of foreign body or pathologic process in the lung to the bronchi, can be definitely recorded on the roentgen-ray film.

We have had no unfavorable consequences from the insufflation of bismuth subcarbonate or the instillation of lipiodol in any of our patients at the Bronchoscopic Clinic, the substances being expelled spontaneously. However, if it is desired, bronchoscopic aspiration may be used for their removal without any danger to the patient. The presence of an acute intercurrent tracheobronchitis is an indication for postponing pneumonography, and in asthmatics and patients with two or more lobes of the lung incapacitated, preparation for bronchoscopic aspiration should be made so that aspiration may be done if dyspnea becomes urgent.

The question of foreign body as the etiologic factor in pulmonary suppuration can usually be answered by bronchoscopic study. This may not always be possible at the first bronchoscopic examination, but repeated bronchoscopic search will eventually be successful. In cases where a foreign body is found and removed bronchoscopically 98 per cent of the patients are cured without further treatment.

Bronchoscopic treatment is carried out in the individual case when it is decided by the surgeon, the internist, and roentgenologist in consultation that the case is not suitable for surgical treatment, or that surgical treatment is to be deferred. Bronchoscopic treatment consists of the aspiration of stagnant secretion, the removal of granulations, dilatations of strictures, and the local application of medication that will aid in restoring the

* Read before the PHILADELPHIA ROENTGEN RAY SOCIETY, January 7, 1926, in a symposium on "Lung Abscess."

bronchial mucosa to normal so that ciliary aid to normal drainage can be re-established. Bronchoscopic aspiration is particularly indicated when the lesion is in or in close proximity to the bronchi where there is deficient drainage, also in the acute cases where there is a definite evidence of aspiration infection. In some cases the administration of autogenous vaccine prepared from the bronchoscopically removed, uncontaminated specimen has been of vastly greater value than vaccines prepared from sputum.

The bronchoscopic treatments are carried out once or twice a week as the lesion and the condition of the patient may indicate. General anesthesia is never used; local anesthesia is used in adults, application of cocaine being made to the pharynx, the larynx and trachea. After the first bronchoscopy cocaine is usually not used in the bronchi, as it is desired that the patient should cough with the bronchoscope in position. It is often surprising to see the large quantity of pus that can be obtained by bronchoscopic aspiration, after the patient has tried to free himself of pus by cough and postural drainage. In children, bronchoscopic drainage is carried out without anesthesia, general or local, and without sedatives. Various medicaments have been used for local medication. Where granulations are present the local bronchoscopic application by swabs of nitrate of silver, in 5 per cent solution, is of value. Local medication by instillation and swab-application of mercurochrome 0.5 to 1 per cent, aqueous solution, gomenol 20 per cent, in liquid petrolatum, monochlorphenol (para) 5 grains to the ounce of liquid petrolatum, have all been used with benefit to the patient.

Under bronchoscopic treatment many patients are made better, many cured, none are made worse. In some cases the progress of the disease has not been arrested. In a few of these cases a more definite localization of the lesion has occurred, making the abscess more accessible to external drainage.

A patient admitted to the Clinic with an abscess of the right lower lobe, on bronchoscopic examination was found to have a pedunculated tumor blocking the lower lobe bronchus. The bronchoscopic removal of a pedunculated tumor of inflammatory origin allowed free drainage and the pathologic process in the area of lung distal to the tumor cleared up, resulting in permanent cure. Another patient at the Clinic had a pulmonary abscess in the left upper lobe and another abscess in the left lower lobe. In consultation it was decided that external drainage be postponed and that bronchoscopic drainage be used to supplement the medical care of the patient, the surgeon to observe the patient regularly in consultation. Bronchoscopic treatment was carried out over a period of six weeks and the abscess in the lower lobe cleared up completely. The patient's general condition improved but the abscess in the left upper lobe did not improve and the surgeon performed external drainage in the upper lobe abscess, resulting in cure, the patient recovering completely.

The results of bronchoscopic treatment can be well illustrated by the following report of a case:

CASE REPORT

A man, aged thirty, following an operation on the mouth under ether anesthesia, developed a pulmonary abscess involving the right lower and middle lobes. The pulmonary symptoms came on within the first week following the operation, five weeks before his admission to the Clinic. When admitted he was running an irregular fever, up to 103°F., the maximum usually at night, and he had the appearance of being severely ill. He was expectorating about 200 c.c. of foul, blood-stained, brownish sputum in twenty-four hours. Roentgen-ray examination by Dr. Pancoast showed evidence of abscess in the right middle and lower lobes. Physical examination by Dr. T. Grier Miller localized a pathologic process in the same area. Bronchoscopic examination showed considerable pus in the trachea, coming from the right main bronchus. The mucosa of the right stem bronchus, middle lobe bronchus, and the lower lobe bronchus was very much inflamed and swollen, the lumen of the bronchi being narrowed to about one-half the normal diameter. Pus was aspirated and was found to be coming from the middle and lower lobe bronchi. Local medication with 2 per cent solution of mercurochrome by means of swabs was carried out.

Dr. George P. Muller saw the patient in consultation and advised that bronchoscopic treatments be tried before resorting to surgical drainage.

Following bronchoscopy the patient's temperature range came down to a lower level. A second bronchoscopy was done after an interval of three days and the local condition of the bronchi was improved. Aspiration was carried out followed by mercurochrome medication. Improvement continued. The offensive odor of the pus noted on the first bronchoscopy was less marked. The quantity of pus expectorated in twenty-four hours was diminished, and all evidence of blood disappeared from the sputum. Bronchoscopic treatments were carried out over a period of three weeks, when the patient's temperature came to normal level and the pus was very much diminished. Treatments were continued with progressive improvement and by the end of six weeks the man was symptomatically well. Bronchoscopic examination at this time showed the bronchi of the right lung to be practically normal in appearance. There was no pus in the lung. The man had gained 25 pounds in weight and was discharged from the hospital and kept under observation as an out-patient. Six months after his first bronchoscopy, he had gained in all 40 pounds in weight and has resumed his usual occupation. Roentgen-ray examination by Dr. Pancoast shows no evidence of pathologic processes in the right lung.

We feel that it would be a mistake to undertake independently the bronchoscopic treatment of lung suppuration. The best interests of the patient are served by the cooperation of the internist, the roentgenologist, the bronchoscopist and the surgeon.

SURGICAL ASPECTS OF LUNG ABSCESS*

BY GEORGE P. MULLER, M.D.

PHILADELPHIA, PENNSYLVANIA

LUNG abscess is a serious disease, the published mortality ranking very high. For this reason, a symposium such as this should be useful in calling attention to current procedure in the hope that the discussion will aid in bringing about better results. The etiologic factors have been much discussed in recent years and we have learned that pneumonia is not the frequent cause as formerly thought. Indeed, Lord[1] from an analysis of 227 cases believes that "lobar pneumonia appears to be of little moment in the etiology, and an origin in bronchopneumonia is uncertain." Hartwell,[2] in an excellent paper on abscess of the lung, is emphatic in stating that pneumococcus lobar pneumonia is a rare antecedent of pulmonary abscess and he states that of 770 consecutive cases of pneumococcus lobar pneumonia admitted to the Rockefeller Hospital, only 2 developed lung abscess, and each of these showed other infecting organisms. Hartwell had 3 cases in which abscess followed pneumonia, but in each case secondary invaders were found in the abscess content and the pneumococcus apparently had no part in its formation. It is true that in all of the reported series a certain percentage is believed to occur after pneumonia, but it is not generally stated whether this is a primary or a secondary infection. It seems to me that the important point brought out by these studies is that the patient with pneumonia should be carefully guarded against secondary infection from the throat and mouth.

Beginning about 1912 our attention was called to the importance of operations on the upper respiratory passages as an etiologic factor in the development of lung abscess, and it is now generally conceded that at least 50 per cent of the cases of lung abscess are due to this cause, and of these 75 per cent follow tonsillectomy. Considerable controversy has arisen as to whether or not general anesthesia induced by motor driven apparatus is the reason for this occurrence. A number of cases have been reported following local anesthesia, and

* From the Surgical Service of the Hospital of the University of Pennsylvania; read before the PHILADELPHIA ROENTGEN RAY SOCIETY, January 7, 1926, in a symposium on "Lung Abscess."

hence the paper by Fetterolf and Fox[3] is of great importance because it shows after animal experimentation that a septic thrombus can form in the throat, be dislodged and produce a lung abscess. They consider that as one of the early signs of pulmonary infarction is the spitting of bright red blood, it is quite possible that, at times, some of the blood spitting in the early days following tonsillectomy is due to an overlooked infarction and not to oozing from the operation. The lesson to be drawn from their experience is that bleeding vessels should be tied on the surface and not by mass suturing which carries infection into the deeper tissues. As this is not a paper upon the etiology of lung abscess I will not discuss further the influence of bronchopneumonia or of septic emboli following operations, other than those on the respiratory tract, on the production of lung abscess.

The treatment of lung abscess resolves itself into adequate drainage of the cavity and dilated bronchioles. We must understand that the abscess may be entirely circumscribed, may be draining into a bronchus or may be represented by several small cavities and a mass of dilated bronchioles (local bronchiectasis). In addition we must recognize the location of the abscess, that is, either in the upper or lower lobes, either at the periphery or near the center of the lung. Willy Meyer has said "that the roentgenologist is the thoracic surgeon's best friend" and there is no doubt that he is the most important factor in determining the exact location of the abscess after the clinical diagnosis has been made. I would suggest from my own experience that in addition to the usual stereoscopic anteroposterior exposures much information may be obtained from a lateral view.

It does not matter as to the method used in producing drainage, collapse and healing of the cavity but it does matter that this is accomplished. At the present time we have at our disposal, postural drainage, bronchoscopic aspiration, the production of artificial pneumothorax, and external drainage by thoracotomy. If I had an abscess of the lung I would first have an accurate diagnosis as to location made by a clinician and roentgenologist. I would place myself under the care of the clinician and a bronchoscopist and for a reasonable time would have them attempt postural drainage and bronchoscopic aspiration. During this time I would like to be in the sun and air as much as possible and to take a high caloric diet. I would wait about two months for cure to occur unless fever was persistent as indicating progressive suppuration or partial gangrene or associated empyema. If the abscess was in a situation not amenable to bronchoscopic treatment, and Dr. Tucker has told us about these cases, I would immediately consult a surgeon. Toward the end of the second month I would expect the roentgenologist to determine whether or not the abscess cavity was simply draining or was healing. If at the end of the two months I was not cured, or practically so, and especially if the roentgenologist assured me that the cavity was draining well but was still existent, I would consider external drainage.

Artificial pneumothorax has been advocated by a number of writers, but does not seem to have been accorded universal acceptance. It would be indicated when the abscess has been present only a short time, is centrally situated and is draining into the bronchus, but these also are the indications for bronchoscopic aspiration. An old abscess with thick walls, and the presence of pleuritic adhesions, are contraindications. There are certain dangers such as the dissemination of septic material into different portions of the lung and the production of a pyopneumothorax by the breaking of a lightly adherent cavity to the chest wall if such adhesion has not been recognized.

The principal objection to surgical treatment *per se* is the high mortality attending its performance, but it seems to me that we are apt to exaggerate this as a consequence of the treatment itself and to fail to remember that the disease is a serious one and that most patients have thoracotomy performed many months after the onset of the abscess. In the series reported by Lord 11 per cent recovered without operation and he estimates that in those cases with a previous duration of two months or less complete recovery may be expected in 22 per cent. On the other

hand, he estimates that persistent medical treatment would result in a mortality of 75 per cent. Lockwood,[4] in 1922, collected 1,117 cases of which the average surgical mortality was 34.6 per cent. Since September, 1922, I have operated on 14 cases with 3 deaths, a mortality of 21.4 per cent. In one of these only a rib resection was done under local anesthesia with the intent of entering the abscess a day or two later because we were uncertain as to whether or not the lung was adherent. The patient promptly died, and at autopsy was found to have multiple bronchietatic cavities.

Methods of exposure and drainage differ somewhat in the opinion of various authorities but it seems to me that simplicity should govern our plan of attack. Few patients are so acutely ill as to require a hurried and immediate operation. Salt water infusions and blood transfusion will tide even the very sick patient over a few days and give time for proper technique. Therefore, I believe that one should do a resection of one or two ribs over the area believed to be the site of abscess, and the more perfect the localization, the more certain will be the success of operation. Some gauze saturated with mercurochrome solution is then packed against the parietal pleura and the skin flap temporarily closed. Two or three days later the wound is re-opened and it will be found that the lung is sufficiently adherent in practically every case. One can then enter the cavity with the cautery and establish drainage with a soft rubber tube. We should be careful not to do much manipulating in the cavity because of the danger of hemorrhage but should be satisfied with the temporary drainage of the highly infected contents, enabling the patient to recover from the condition of sepsis. All of these procedures should be done strictly under local anesthesia. There may be secondary cavities or there may be bronchiectatic areas and hence it is necessary in a short time to inspect the cavity and to consider the condition of the patient as to whether or not we should practice the cautery pneumectomy as introduced by Graham and Singer[5] in 1923. At several stages the entire bronchiectatic area can be burned away. This method is much superior to partial lobectomy because as shown by Graham[6] the mortality in the 48 reported cases of lobectomy for bronchiectasis was 52 per cent, and Graham reported 20 cases of chronic lung suppuration with a mortality of only 20 per cent and a complete cure of 30 per cent. One must not be led by these brief statements into believing that all abscesses require this method of procedure. Many abscesses are distinctly circumscribed and need drainage only, but there are others in which the bronchiectatic element is present and simple drainage does not produce a cure. These are the ones suitable for Graham's cautery method. I must emphasize the necessity for continuing drainage for a very long time. Six months, at least, should elapse before the tube is removed, especially if there is evidence of persistence of a bronchial fistula. In a sense this is the lung-lip fistula method of Willy Meyer. These patients should continue under the mutual care of the clinician, bronchoscopist, roentgenologist, and surgeon, because "flare-ups" frequently occur and sometimes serious symptoms suddenly ensue after recovery seems assured. In a patient now under our care in the surgical ward of the University Hospital we have asked Dr. Tucker to continue bronchoscopic aspiration even though external drainage has been produced. We are hoping that an extensive cautery operation may be avoided by this means.

In conclusion, I would urge the extreme gravity of this disease, the fact that the mortality is necessarily high, and that we must not be hide-bound in our methods of procedure.

REFERENCES

1. Lord, F. T. Pulmonary abscess. *Boston M. & S. J.*, 1925, cxcii, 785–788.
2. Hartwell, J. A. Abscess of the lung. *Ann. Surg.*, 1920, lxxii, 333.
3. Fetterolf, G., and Fox, H. Reaction of paratonsillar tissues to tonsillectomy; study in etiology of posttonsillectomy pulmonary abscess. *Am. J. M. Sc.*, 1923, clxvi, 802–825.
4. Lockwood, A. L. Abscess of the lung. *Surg., Gynec. & Obst.*, 1922, xxxv, 461–492.
5. Graham, E. A., and Singer, J. J. Abscess of the lung. *J. Am. M. Ass.*, 1923, lxxxi, 193–194.
6. Graham, E. A. Surgical treatment of bronchiectasis. *Arch. Surg.*, 1923, vi, 321–336.

THE HILUM IN TUBERCULOSIS

BY A. G. SCHNACK, A.M., M.D.

HONOLULU, T. H.

THE tendency of modern medicine is toward prophylaxis and the early recognition of disease. Tuberculosis, with its gradual onset and its infinitely variable course, offers extreme difficulties in the determination of exact degrees of activity or healing. Therefore, anything in the way of history, physical findings, and roentgenologic interpretation that might aid in diagnosis is always desirable. We shall present a few findings which we believe are of value in diagnosing certain forms of early and mildly active tuberculosis. These findings have already been described but we wish to give them their more rightful importance. We shall first recall some generally offered ideas before we present the object of this paper, so that our viewpoint may be more easily comprehended. Our material has been very profuse, owing to the great addition of Oriental races whose hygiene thus far is much below that of other races. Close contact and long exposure through many generations has, in a large proportion of these cases, produced a partial immunity with a resulting low-grade type of active tuberculosis; a type of case which we would not consider for sanitorium treatment.

The intensity of symptoms of tuberculosis we recognize as parallel to the extent of invasion and the degree of inflammatory reaction (allergy, hypersensitivity, vascular permeability, etc.[1]). The healing process, in the final analysis, depends upon the production of an avascularity of the infected area through a fibrous tissue production and perhaps lime salt deposit. This fibrosis will generally, under the microscope, show a definite cellular infiltration, and must be an imperfect barrier against a small but definite amount of diffusing tuberculosis and tissue toxin. A very widely scattered fibrotic condition will therefore, we believe, because of its comparatively large area, be associated with toxic symptoms comparable to those produced by a small but definitely active lesion.

We should differentiate, if possible, the various degrees of activity. We know that with a high degree of allergy a marked focal exudative tissue reaction may follow a slight reinfection with tubercle bacilli, whether the reinfection is from without, or by metastasis.[2] A similar reaction in a hypersensitive individual will often follow an infection by an entirely different organism. The frequent surprisingly rapid clearing up of a chest, with the removal of foci of infection, makes one hesitate in judging the true relationship of allergy and immunity. That allergy merely represents immunity hardly confirms our usual ideas of prognosis when viewing an exudative perifocal inflammatory area in a roentgenogram. It no doubt represents an active combatting of an infection. With a high degree of allergy a large area of exudation may lead directly to cellular necrosis and cavity formation. The formation of cavities in lungs responding with a large exudative reaction would hardly show a parallelism between the degree of allergy and beneficial immunity. That the exudative reaction fixes and combats the infection *in situ* and temporarily prevents dissemination may well be, but the "cure may ultimately be worse than the disease." The expelling of an infective necrotic focus may be the perfect method for the clearing up of an ordinary boil, but the same method of eliminating infection is costly and dangerous in the lung.

Our ideas of the specificity of the tuberculous reaction, local, focal, and constitutional, are not thoroughly established. The stimulation of tuberculous and general focal infections by the injection of nonspecific proteins and numerous other substances, organic and mineral, makes one hesitate in accepting some of these laboratory tests as specific for tuberculosis.[3]

It has been practically proven that most tuberculous infection is transported by phagocytosis through the endothelial leucocyte, which confines the infection

primarily to the lymphatic system, although there may subsequently be involvement by contiguity and through other channels. While the infection is confined to the lymphatic system the symptoms may be very slight, even with a widespread infection.[4]

Inasmuch as the tuberculous infections which show a comparatively small perifocal inflammatory reaction tend toward fibrosis and avascularity, we would favor this type as offering the better prognosis. The developing hypersensitivity might subsequently, however, with reinfection produce a marked exudative reaction about these same areas. Complete fibrosis would tend toward a lessened hypersensitivity and a much better prognosis with reinfection. It is therefore necessary that we differentiate, if possible, between these slightly exudative types of infection and the truly fibrosed or healed lesions.

Our clinical findings are of great importance but no more so than our roentgen interpretations. Many of these so-called failures in roentgen interpretation may be laid to poor plates, or failure to take advantage of everything the plates have to offer. As the clinician often demands a longer period of time before he can be reasonably certain in his diagnosis, so the roentgenologist should be accorded in some cases the advantage of a re-examination before giving his final interpretation. With outspoken cases of tuberculosis clinical findings may be well defined, but there may be no findings of importance associated with the mildly active cases we wish to describe. We should also look more for "subliminal"[5] symptoms. Some of these may be mentioned, for example, a lack of cardiovascular tone, as evidenced by low pulse pressure and a considerable variation in blood pressure on standing and lying down, fatigue, irritability, insomnia, frequent chest "colds," and in general a feeling of being just a little "below par." These symptoms may be found with constipation and numerous other conditions. The clinician who overlooks these milder signs and symptoms is continually at variance with the roentgenologist.

The generally accepted view of a healed process is one showing a discrete well-demarcated fibrotic or calcified area with no perifocal inflammatory zone. The personal equation, the acquired and natural immunity (agglutinins, precipitins, opsonins, lysins, etc.), the strain of organism, and the temporary increase or decrease in hypersensitivity must necessarily affect the degree of exudation about a tuberculous focus. Many foci reveal themselves by showing triangular areas of varying density

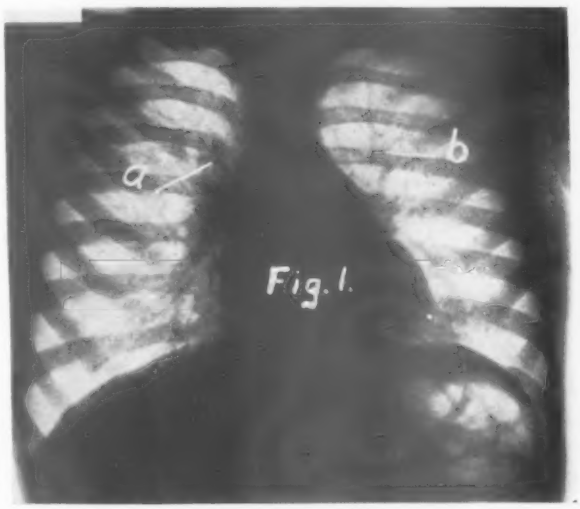


FIG. 1. This is a child's chest and shows at *a* a tuberculous process which is apparently extending outward from the hilum, the primary area of infection on this side. At *b* we believe the process is more like that in the adult where the process extends downward toward the hilum from the lung periphery.

confined to one or more secondary lung lobules. We find as the exudate clears in these so-called "fans"[6] there may be only small areas of actual tuberculous infection present. In other cases the exudation may precede caseation and liquefaction necrosis with cavity formation, while in others the entire area may be invaded by reticular and fibrous tissue with a shrinking avascular lung scar resulting. In many cases allergy or hypersensitivity may be poorly developed and the evidence of infection may be limited to the lymphoid follicles and nodes. These follicles, as pointed out by Miller[7] are found about the bronchioles and pulmonary arteries and veins where they branch, and also in patches about the visceral pleura and secondary lobule septa

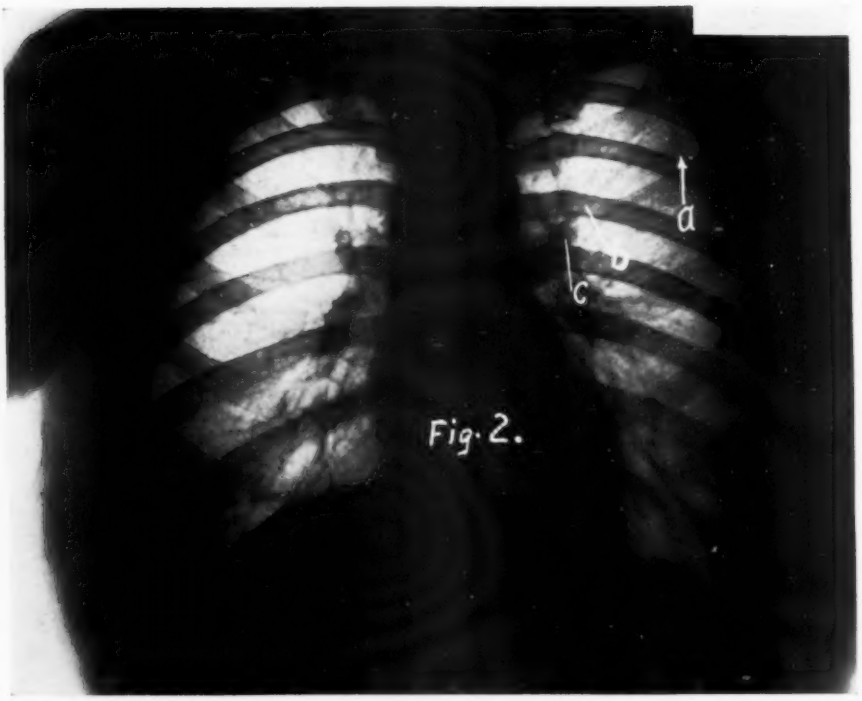


FIG. 2. There is a very light but definite peripheral "fan" at *a*. At *b* we have the furred and more numerous lung markings extending outward from the hilum *c*, which in the original plate shows some definite clouding, as compared with the remainder of the hilum.

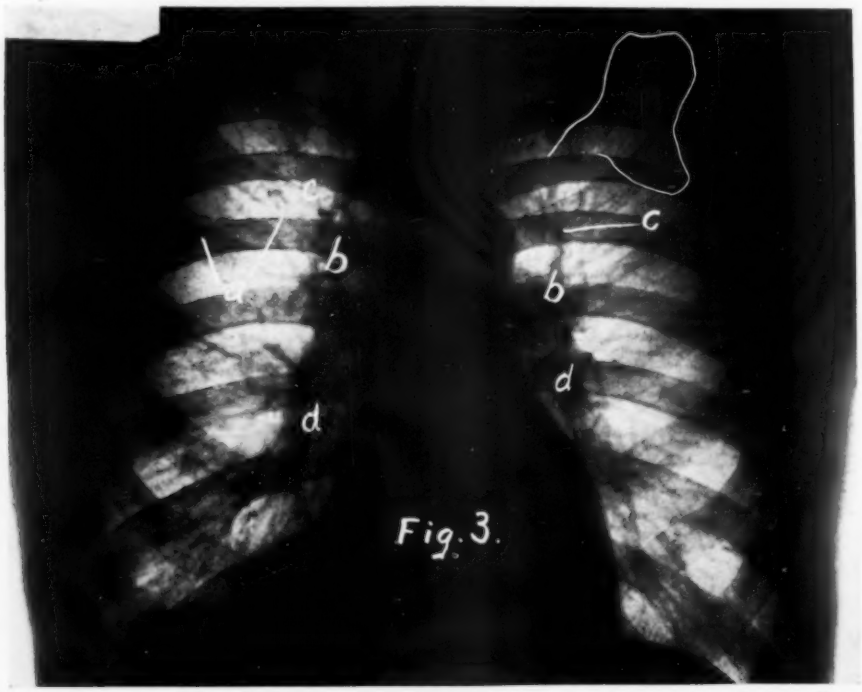


FIG. 3. Here we have no "fans" but we find the lung markings, beaded and furred, extending into the lung periphery of both upper chests. At *a* we find much interlacing of the vascular lung markings which is often found with early tuberculosis. At *b* we find the hila clouded. The lung markings at *d*, although thick and prominent are discrete.

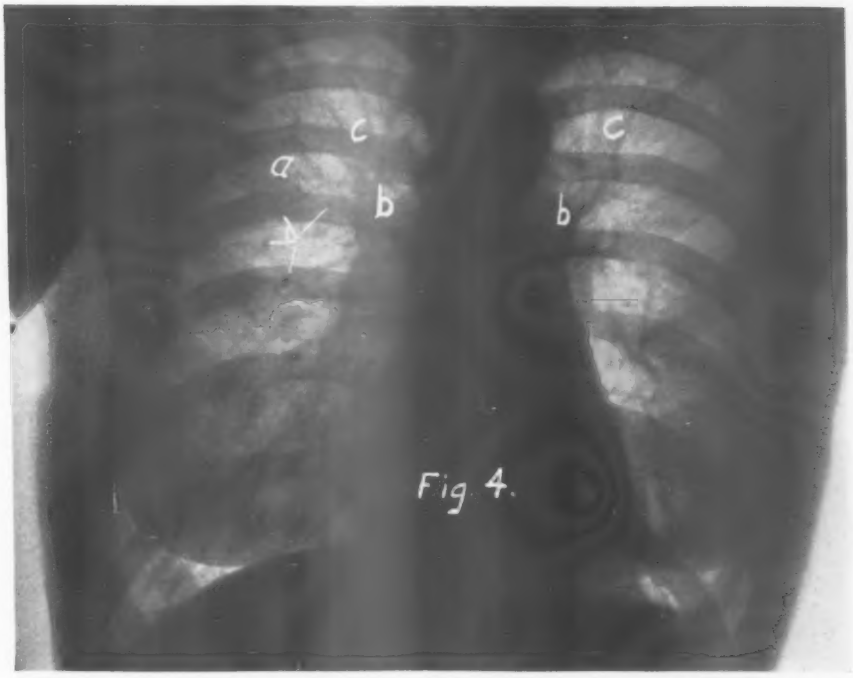


FIG. 4. This is very similar to Figure 3. We have at *d* the small calcified lymph follicles, indicative of an earlier healed infection (puerile tuberculosis).

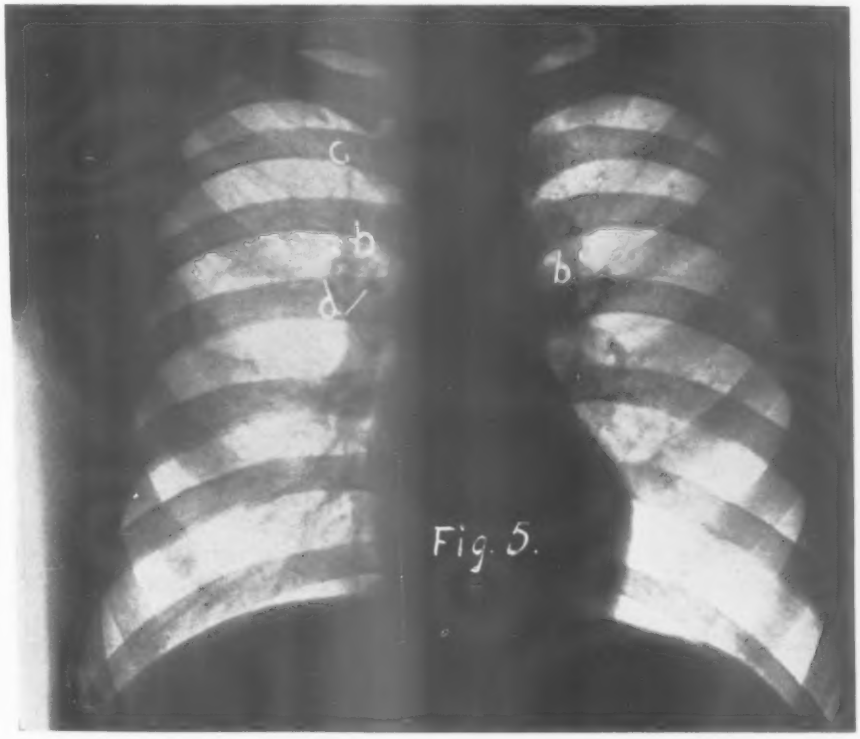


FIG. 5. Shows evidence of a process approaching the quiescent stage. The markings at *c* and beyond are only slightly furred, and there is only slight hilum clouding at *b*.

which carry the main lymphatic trunks, generally in close association with the pulmonary veins. This lymphoid tissue increases in amount with advancing age and with continued irritation from various sources.[8] These lymphoid collections of tissue under ordinary circumstances are not made out with any degree of certainty in plates of normal lungs, but will produce along the course of the normal lung markings furry densities (beading) when irritated by tuberculous and tissue toxins. These furry densities, especially when extending downward toward the hilum, along the course of the lung markings. In this type of infection we have often found associated a great increase in the linear markings radiating outward from the hilum. These markings seem not only more numerous but are definitely broader than normal markings. They may frequently be branched near the hilum and may show much interlacing nearer the lung periphery. There may be associated a more or less furred beading of these markings. There is also to a greater or lesser degree a certain

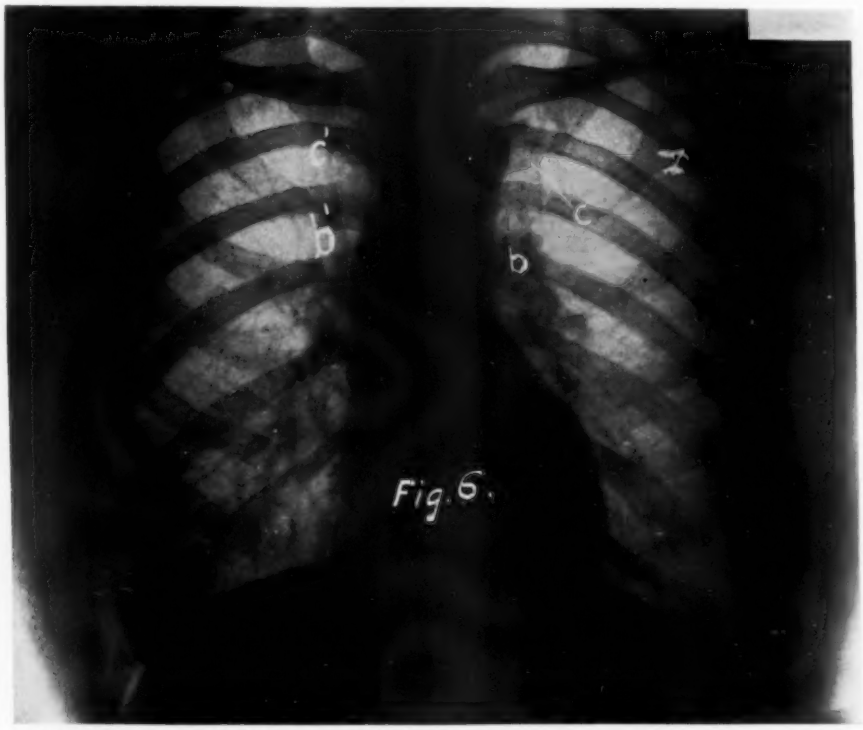


FIG. 6. Shows a healed process at the right apex while the left upper chest still shows evidence of a low grade activity.

found in the lung parenchyma, lead one to suspect a definite degree of irritative exudate, signifying an active process. We may find subpleural activity in the shape of a "fan" with nothing else abnormal in the plate. This can conveniently be ascribed to lymphatic drainage toward the pleura with probable fixation of the toxic irritative material in the pleural lymph follicles. This is oftener found after the "fan" has become invaded by reticulum and is becoming avascularized. In other cases we find much irregular beading clouding and broadening of the denser portion of the hilum shadow. We feel that these hilum changes are of considerable importance and should not be confused with peribronchial tuberculosis or tuberculosis originating and radiating from the hilum. They are of special importance when we find increased parenchymal markings and cannot be certain that these show evidence of irritation. These thickened lung markings when directed toward a single suspicious area of doubtful parenchymal involvement are, we believe, of

certain diagnostic value. These increased markings are undoubtedly due to venous and lymphatic engorgement brought about by an increase in the tissue elements and swelling of the lymph follicles, and bronchial and hilum nodes, through the drainage of toxin and perhaps bacteria from the infected zones. Where in normal lungs we find only the larger venous trunks we now also find evidence of engorged venous branches and lymphatics. As the peripheral process heals we find an increase in the radiating markings persisting, but they gradually become more and more discrete and thinned out, and do not give the congested appearance associated with the active parenchymal type of lesion. In childhood we find fewer hilum markings in the normal lung but with a little parenchymal involvement; a large area, perhaps an entire lobe or more, may show a clouded appearance from congestion secondary to hilum swelling and obstruction, with the radiating hilum markings described above. With the "open" lymphatic system of early childhood a general increase in the hilum markings is more frequently noted with infection, but we do find frequently, a marked increase in radiating markings directed toward a single doubtful parenchymal zone. When the entire hilum shows a uniform congestion with uniformly thickened radiating markings, unless we find definitely active parenchymal lesions, this should not be given too great diagnostic importance; as cardiac conditions, valvular, or toxic myocardial, cardiac pneumofibrosis,[9] acute and chronic bronchitis, pneumoconiosis, acute and chronic asthma, pertussis, bronchiectasis, mediastinal tumors, and numerous other conditions will produce these hilum changes. An extensive lesion in one chest will produce a hilum congestion on the opposite side. Plates taken with the patient in the horizontal position may show a uniform hilum conges-

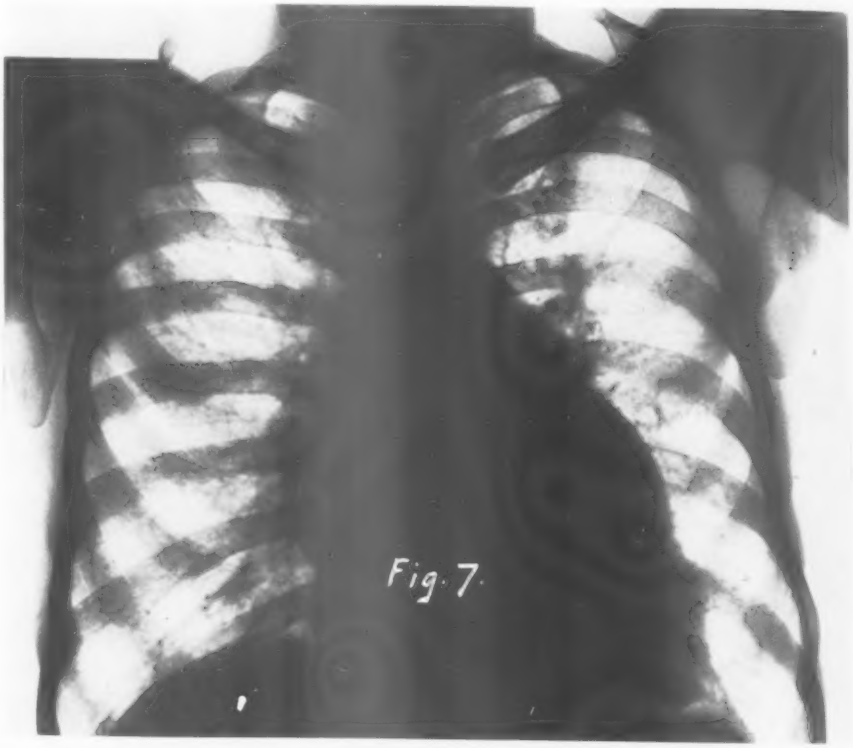


FIG. 7. A case of long-standing mitral stenosis showing cardiac pneumofibrosis. There is a marked but general hilum congestion, with the increased markings extending in all directions into the lung periphery. The markings in cardiac cases with pulmonary congestion have a tendency to taper toward the periphery and do not show the small peripheral furred enlargements described above.

tion. With advancing age there is a general but discrete increase in hilum markings, in some cases resulting from long mild irritation, while in others from repeated "colds" and lung infections. As our lymphatic system, owing to calcification and fibrosis and increase in cellular elements becomes more "closed" we find a tendency to chronic general hilum changes, but there may often, even now, be found a localized vascular hilum change, pointing to congestion secondary to a parenchymal lesion.

The accompanying figures illustrate some of the points mentioned above. Unfortunately, the detail in these reproductions is partly lost.

In concluding, we may say that a thorough knowledge of the markings of healed lesions and normal chests (these are rare) must first be had, before deciding on degrees of abnormal lung markings. The vertebral and first and second interspace trunks with their subdivisions normally form a formidable array of markings, but their character is discrete, and we do not find the local hilum clouding which we see with the pathological processes we have described. Only stereo plates showing the finest detail and good contrast can be used.

REFERENCES

1. Petersen, William F., and Levinson, S. A. Alterations in endothelial permeability and their relation to the tuberculous focus. *Am. Rev. Tuberc.*, 1923, viii, 122–137.
2. Bushnell, G. E. Immunity through tuberculous infection. *Mil. Surgeon*, 1913, xxxii, 29–51.
3. Opie, E. L. Inflammation. *Arch. Int. Med.*, 1910, v, 541–568.
   Petersen, William F. The focal reaction. *Am. Rev. Tuberc.*, 1921, v, 218.
4. Krause, A. K. Human resistance to tuberculosis at various ages of life. *Am. Rev. Tuberc.*, June, 1925, xi, 303–354.
   Haythorn, S. R. Some factors concerned in the dissemination of tuberculosis in experimental animals. *Am. Rev. Tuberc.*, 1922, vi, 731–765.
5. Sewall, Henry. The importance of subliminal symptoms and period of alternation of rest and exercise in treatment of pulmonary tuberculosis. *Am. Rev. Tuberc.*, 1921, v, 236.
6. Dunham, H. K. *X*-ray examination of the chest and an *x*-ray classification of pulmonary tuberculosis. Am. J. Roentgenol., 1921, viii, 427.
7. Miller, W. S. Some essential points in the anatomy of the lung. Am. J. Roentgenol., 1917, iv, 269; Studies on the normal and pathological histology of the lung. *Am. Rev. Tuberc.*, March, 1925, xi, 1–18.
8. Willis, H. S. Studies on tuberculous infection; spontaneous pneumokoniosis in the guinea pig. *Am. Rev. Tuberc.*, 1921, v, 189.
9. Holmes, G. H., and Dann, D. S. Cardiac pneumofibrosis. Am. J. Roentgenol. & Rad. Therapy, 1923, x, 343–350.

THE USE OF IODIZED OIL (LIPIODOL AND IODIPIN) IN THE ROENTGEN-RAY DIAGNOSIS OF SPINAL LESIONS*

BY ERNST A. SCHMIDT, M.D.

DENVER, COLORADO

AFTER various attempts to visualize the spinal theca by means of radiopaque solutions had failed (Krause, Simons, and others[1]), Sicard and Forestier succeeded in solving the problem by cisternal and lumbar injections of iodized oil (lipiodol). Since the first publication[2] of their discovery in 1921 numerous articles have appeared in American as well as in foreign literature which seem to establish definitely the diagnostic value of the method. Since, in the meantime, the use of lipiodol has been extended considerably—to the diagnosis of bronchopulmonary diseases, of pathologic conditions of the vascular system, the genitourinary tract, sinuses etc.—the method has gained, and is still gaining, in importance.

Lipiodol, a French preparation, as well as iodipin, its German rival, had been used extensively in therapeutics on account of its iodine content before the radio-diagnostic properties were utilized. There seems to exist no marked difference between the two preparations as far as radiopacity and physiologic effects are concerned. The iodine content is the same in both products, i. e., 40 per cent by weight. As no American preparation has been marketed as yet and iodipin has not been available in this country until recently, all of our personal observations have been confined to lipiodol. As for iodipin, we depend entirely on publications in German and Austrian medical literature.

We used the original "Lipiodol Lafay," a transparent oil of amber-yellow color and a high specific gravity (1.350). Its radiopacity is explained by the high atomic weight (127) of its iodine component, while its heavy density explains its passage, according to gravitation, from the cisterna magna to the lumbar cul-de-sac. Variations of this normally rapid passage indicate obstructive changes in the spinal theca.

A more recent modification of lipiodol is the so-called "lipiodol ascendant" or "lipiodol montant." It is lighter than the spinal fluid and, as indicated by its name, ascends in the spinal canal when injected into the lumbar sac. Its use is recommended not only for myelography, but also for ventriculography. The diminution of its iodine content naturally reduces its value as a contrast medium. Peiper[3] rejects it entirely on account of its poor radiopacity and its tendency to adhere to the membranes of the spinal canal in ascending.

The technique of the injections of iodized oil for myelographic purposes has been described frequently: In recumbent position, 1 to 2 c.c. are injected by suboccipital puncture into the cisterna magna (Fig. 1). The patient is then placed in a sitting or standing position and roentgenograms are made immediately after injection, after one hour, after six hours, twenty-four hours and seven days. During all this time it is advisable to keep the patient in bed in a sitting position. In occasional cases where this seems impossible, considering the general condition of the patient, care should be taken to have the patient sit up for at least several hours preceding the roentgen-ray exposures. Some observers prefer a half-erect position of the patient in order to avoid the uncharacteristic globulation of the oil when meeting with an obstruction. As a rule, the injected oil reaches the spinal cul-de-sac in a very short time, forming a large round oval or irregular globule at the lowest level of the lumbar sac. Occasionally some delay is observed at the level of the fourth dorsal vertebra, the anatomically narrowest part of the spinal canal. (Case XIV of our series.) Frequently small particles of iodized oil are noted in the lateral portion of the lumbar spine. These minute retentions, as well as delays of a short duration (less than forty-eight hours) are, as a rule, not considered pathologic by most neurologists and roentgenologists, although the

* From the X-Ray Department of the Colorado General Hospital, University of Colorado Medical School, Denver, Colorado.

possibility cannot be denied that, by the indiscriminate practical application of this viewpoint, in certain cases a slightly marked pathologic condition may be overlooked.

From August to December, 1925, fifteen patients were examined, following the above described technique, in the roentgen department of the Colorado General Hospital. All patients were cases of the Colorado Psychopathic Hospital (Director: Dr. Ebaugh; Associate Director: Dr. Mella). The lipiodol injections were made by Drs. Ebaugh and Mella, to whom I am indebted for the histories and clinical data of the cases. The diagnosis was: general paresis in 5 cases; multiple sclerosis in 3 cases; subdural tumor in 1 case; history of old spine or head injury in 3 cases; kyphoscoliosis (and psychosis) in 1 case; degenerative neurologic lesions in 2 cases. The roentgenograms showed deviation from the normal in 7 cases (47 per cent). While in 4 of the cases roentgen-ray findings were definitely pathological (27 per cent), the pathologic significance of the findings in the remaining 3 cases is still under question.

A brief résumé of the 4 unquestionably positive cases (1 case of multiple sclerosis, 2 cases of old neck injury, 1 case of subdural tumor) follows:

FIG. 1. Showing injection of lipiodol into cisterna magna (anterior part of needle visible).

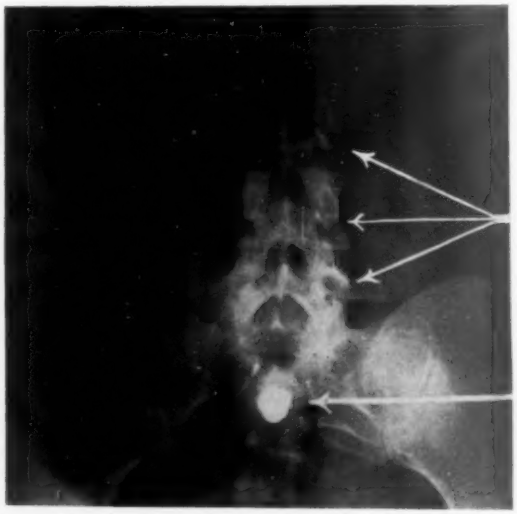


FIG. 2. Showing large globule of lipiodol at lowest level of spinal cul-de-sac. Note small particles of lipiodol at posterior roots (Case XII).

CASE REPORTS

CASE IX. J. Ma., male, aged forty-five. Complaint: Backache, loss of strength, inability to work. Clinical diagnosis: Probably multiple sclerosis; spondylitis deformans.

Roentgen findings after injection of lipiodol (11/23/25): "Roentgenogram during injection shows needle in cisterna magna, lower column of lipiodol reaching fourth cervical vertebra (Fig. 1). After one hour and six hours part of solution, approximately one-half, in sacral region, small part (in stripe form) in region of third and fourth lumbar vertebrae, and the rest about the fourth and fifth dorsal vertebrae. After twenty-four and forty-eight hours lipiodol in thoracic spine leaking farther down reaching the ninth dorsal vertebra. After seven days position of lipiodol in dorsal spine same as after twenty-four and forty-eight hours. Globule in cul-de-sac unchanged. Minute particles at higher levels of lumbar spine still present."

CASE VIII. M. Ho., male, aged forty-seven. History of neck injury followed by severe pain in right lumbar region, nausea and vomiting. Paranoid delusions. Clinical diagnosis: Degeneration of the pyramidal tract on the left side of the spinal cord, probably as a result of trauma, questionably syphilis.

Roentgen findings after lipiodol injection (10/15/25): "Small amount of lipiodol in the spinal cul-de-sac. Small amount of lipiodol shows after twenty-four hours, forty-eight hours and seven days in the upper portion of the

thoracic spine, shifting between the first and third dorsal vertebra."

CASE X. D. Me., male, aged forty-five. History of head injury in 1904. Present complaint: Numbness of hands and legs with intermittent attacks of staggering gait. Diagnosis: Old fractures of first and second cervical vertebrae with cord injury.

Roentgen findings after lipiodol injection (11/20/25):

"Lipiodol column reaches after one hour the lower border of the third cervical vertebra, after six hours and twenty-four hours the first dorsal vertebra and, after seven days, the level of the second dorsal vertebra. Partial retentions are seen above these levels at different parts of the cervical spine (roentgen-ray evidence of old injury to the first and second cervical vertebrae—apparently fractures of the atlas and axis, and forward dislocation of axis—)." (As for later examination and figures of this case, see below.)

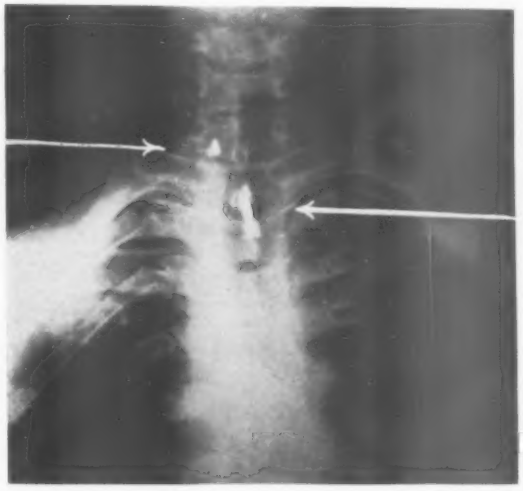


FIG. 3. Complete block at level of second dorsal vertebra. Partial retentions in cervical spine three months after injection of lipiodol (Case x).

FIG. 4. Same case as Figure 3. Lateral view.

CASE XV. H. Ka., female, aged fifty-two. Complaint: For three months severe pains across lower part of back, in hips and posterior parts of legs down to heels; difficulty of voiding; inability to stand or to walk or to move feet or legs.

Neurological Examination: Hyperesthesia over back and abdomen; tenderness over ninth dorsal vertebra; absence of epigastric and abdominal reflex; occasional involuntary contractions of lower extremities; paralysis of definitely spastic type; bilateral positive Babinski and ankle clonus; exaggerated knee jerks and Achilles reflexes; touch sense intact in left leg, inconstant over right thigh; sense of pain and temperature intact over left leg, inconstant over right thigh; loss of sense of position in both legs. Provisional clinical diagnosis: Dorsal myelitis or tumor of the spinal cord.

Roentgen findings after lipiodol injection (11/3/25) (Fig. 6): "Arrest of opaque solution at lower border in all pictures, one hour, six, twenty-four, forty-eight hours and seven days after injection. Retention of smaller globules of lipiodol between seventh and tenth dorsal vertebrae. No lipiodol reaches the lumbar spine. Roentgen diagnosis: Block at tenth dorsal vertebra with partial retentions between seventh and tenth dorsal vertebrae, probably due to tumor of the spinal canal."

The roentgen-ray diagnosis was confirmed by laminectomy (Dr. Lyman). A tumor with extensive bone involvement but without involvement of the cord was found in the spinal canal extending from the seventh to the tenth dorsal vertebra. The microscopic diagnosis of the tumor specimen (Dr. Mills) was: Secondary carcinoma. The primary seat of the tumor could not be ascertained.

Less definite were the roentgen-ray findings in a case of kyphoscoliosis (with affective disorders) (Fig. 5), in a case of general paresis with mainly optical symptoms, and in a case of paralysis of both legs, a residual from polio-encephalitis.

While the cases of kyphoscoliosis and general paresis differed by unusually long delays of small globules of opaque solutions at different parts of the dorsal and lumbar spine the roentgen picture in the paralyzed

patient showed marked retentions of small lipiodol particles in the region of the posterior lumbar roots (Fig. 2). Whether these—permanent—retentions, which have never been described so far, may be utilized for the interpretation of pathologic affections of the posterior roots or whether they merely represent incidental normal findings cannot be decided. We hesitate, too, to base a diagnosis of pathology on a simply delayed oil passage even if the delay exceeds forty-eight hours. That a marked deviation and curvature of the spine influences the time of passage is evident. To attribute eventual delays to independent lesions within the spinal canal appears superfluous. In the case of general paresis there were found signs of hypertrophic arthritis involving the lower part of the dorsal spine, but it is uncertain whether the delay in the lipiodol passage which occurred between the tenth and eleventh dorsal vertebrae can be connected with this observation.

In none of the 15 cases did we succeed in obtaining a complete reversion of the oil passage by the shoulder-and-head-down-position as described by Forestier and others. The reflux of lipiodol never passed the lower dorsal spine. We refer, of course, only to cases where the unhindered passage of lipiodol had excluded any thecal obstruction. We are at the present time repeating these experiments with the lighter variety of lipiodol ("lipiodol ascendant").

The local and systemic effects in our cases following the lipiodol injections have been dealt with in a special study by Ebaugh and Mella.[4,5] They summarize the systemic effects as follows: Pains in the legs in 30 per cent; slight rise of temperature (up to 101.6°F.) in 23 per cent; nausea and headaches in 7 per cent; leucocytosis in 30 per cent; decrease of leucocytes in 60 per cent; frequent affection of the sleep curve, and restlessness in many instances.

FIG. 5. Showing temporary retention of small globules of lipiodol in dorsal and lumbar spine in kyphoscoliosis (Case XIII).

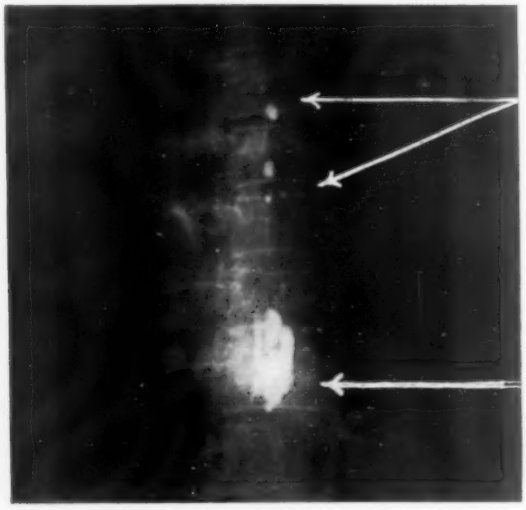


FIG. 6. Showing complete block at lower level of tenth dorsal vertebra and partial obstructions from seventh to tenth dorsal vertebrae in case of intraspinal tumor (Case XV).

Regarding the local effects, the cellular increase in the spinal fluid, as well as the increase in quantitative protein, and the frequency of bloody taps—27 per cent compared with 0 per cent in 50 lumbar punctures taken at random from the hospital records—proved beyond doubt the production of an aseptic meningitis by the lipiodol injections. These findings confirmed previous analogous findings by Ayer[6] in animal experiments. Although this meningitis, together with the systemic symptoms, disappears within several days without apparent sequelae, it constitutes, according to Ebaugh and Mella, a contraindication in inflammatory conditions, and stresses the necessity of thorough pre-

liminary neurological and laboratory examinations.

Late untoward effects as recorded by Sharpe and Peterson[7] have so far not been observed by us, but we admit that our time of observation is not sufficiently long as yet to say definitely. Sharpe and Peterson reported 3 cases of marked inflammatory reactions several months after injection of lipiodol. One of these reactions was so severe as to necessitate laminectomy and operative removal of the encysted globules of lipiodol, five and a half months after injection.

One of our cases (Case x) (Figs. 3 and 4) was examined three months after the lipiodol injection. There was no evidence of absorption of lipiodol or any change in the position of the oil globules as compared with the previous examination. As there was no shifting of the oil on change of position of the patient, it was concluded that encystation had taken place. The patient showed no signs of irritation.

Other sequelae following the injection of iodized oil and mentioned by different authors, e. g., transitory paresis of the nervus facialis (Purves-Steward); dyspnea and bilateral paresis of the nervus abducens (Wartenberg[8]); caudal neuralgia (Krause), were not observed in our series of cases. Probably part of these observations were due rather to lesions of the medulla caused by faulty technique than to the effect of the iodized oil. (One reported case of death of a boy two weeks after lipiodol injection was demonstrated to have been due to miliary tuberculosis.[3])

Nevertheless, the former viewpoint that lipiodol is completely non-irritating to the delicate membranes of the spinal theca and can be injected "with unlimited tolerance" (circular of the manufacturer) can no longer be upheld. The principal danger is involved by the extremely slow absorption of the iodized oil in its present form. As according to Peiper only 5 to 6 milligrams of the injected oil are secreted daily, 1 or 2 c.c. injected by intracisternal puncture require one to two years to be completely eliminated. During all this time the oil forms a "foreign body." Besides, Klose[9] has proved by animal experiments that an overdosage of iodized oil will produce severe alterations of the ganglia cells (chromatolysis and achromatosis) together with infiltrative processes along the central canal. Caution, too, seems to be necessary even with smallest doses , in cases of iodine anaphylaxis and disturbance of the iodine metabolism (hyperthyroidism). Another reasoning seems, in our opinion, to contradict the assertion of the absolutely harmless and indifferent character of iodized oils: their extensive use in therapeutics. Lipiodol, for instance, is recommended against "arterio- and presclerosis in all stages, asthma, emphysema and all chronic affections of the respiratory tract, chronic rheumatism, arthritis deformans, gout, sciatica, lumbago, lumbar-arthritis, rheumatoid troubles, arthritis simple and blennorrhagic, etc., lymphatism, adenoids, scrofulo-lymphatism, adenoid growths and all lymphatic states in childhood and adolescence, tertiary and hereditary syphilis." In the last disease it is described as "the only one of all injected iodine preparations which possesses a preventive power which has been distinctly established, etc." If these therapeutic claims be true, lipiodol cannot be so absolutely indifferent and irrelevant as it is supposed to be in diagnostics.

CONCLUSIONS

The diagnostic importance of iodized oil in the roentgen-ray diagnosis of spinal lesions has been definitely established. The method is of special value in the diagnosis and exact localization of tumors of the spinal canal. As demonstrated in our series of examinations, injections of iodized oil into the spinal theca may further give valuable information in other neurological conditions, e. g., multiple sclerosis, spine injuries, etc., although the results are not constant and our present state of experience often does not permit definite conclusions. The dangers and disadvantages of the method should not be disregarded. Apart from the direct danger of a medullary lesion by faulty technique, the intraspinal injection of iodized oil constantly produces a transitory aseptic meningitis with more or less severe local and systemic symptoms. Late sequelae may result from irritation ("foreign body action") by the

extremely slowly absorbable oil. The problem of myelography may be considered solved as far as the principles and the technique of the method are concerned. It is not solved as far as the contrasting medium is concerned. Both iodized oils available at the present time, lipiodol as well as iodipin, should be used only under the strictest observation of indications and precautions.

REFERENCES

1. Krause, P. Pathologie und Therapie der Meningitis tuberculosa. *Deutsche med. Wchnschr.*, 1912, xxxviii, 1913–1916.
2. Sicard, J. A., and Forestier, J. Méthode radiographique d'exploration de la cavité épidurale par le lipiodol. *Rev. neurol., Par.*, 1921, xxviii, 1264–1266.
3. Peiper, Herbert. Ergebnisse der Röntgendiagnostik der Erkrankungen der Wirbelsäule und des Rückenmarks vom Standpunkt der Iodipininjektion. *Deutsche med. Wchnschr.*, Jan. 1, 1926, lii, 22–25.
4. Ebaugh, F. G., and Mella, H. The use of lipiodol in the localization of spinal lesions. *Am. J. M. Sc.* (in print).
5. Ebaugh, F. G. Use of lipiodol in the localization of spinal lesions. *Am. J. M. Sc.*, 1925, clxix, 865.
6. Ayer, J. B. Puncture of the cisterna magna. *Arch. Neurol. & Psychiat.*, 1920, iv, 529.
7. Sharpe, William, and Peterson, Carl A. The danger in the use of lipiodol in the diagnosis of obstructive lesions of the spinal canal. *Ann. Surg.*, January, 1926, lxxxiii, 32–41.
8. Wartenberg, R. Suboccipital Puncture. *Med. Klinik*, 1924, xx, 665–670.
9. Klose, H., and Peiper, H. Myelography. *Arch. f. klin. Chir.*, 1925, cxxxiv, 303–387.

THE RADIATION TREATMENT OF MALIGNANCY*

BY G. W. GRIER, M.D.

PITTSBURGH, PENNSYLVANIA

THE high voltage or so-called "deep therapy" method of roentgen-ray treatment has now been in general use in this country for about four years. This is a sufficient period of time for us to begin to draw conclusions as to what has been accomplished by this addition to our technique. In the first flush of enthusiasm which followed the introduction of the method, no doubt many extravagant claims were made which later failed of substantiation. The eagerness with which the medical profession turns to any new method advocated for the treatment of malignancy is an unconscious admission of the inadequacy of existing methods. Along with many other remedies before and since, "deep therapy" was hailed for a time as a panacea for cancer. This hope failing to materialize, the pendulum is rapidly swinging the other way and one is beginning to read and hear with increasing frequency that "the *X*-ray is no good for deep-seated malignancy." The truth of the matter is, of course, that "deep therapy" is not a new remedy at all, but an improvement in roentgen-ray technique. The fundamental factors that have always governed roentgen-ray treatment apply equally to deep therapy with the single exception that larger doses may be delivered to deep-seated parts by this method. There are many different reasons why any given case of deep-seated malignancy may be incurable by roentgen-ray treatment. One of these reasons is inability to apply enough roentgen rays to the lesion to destroy it. This is the only factor that is altered by the deep therapy technique and if it happens to be the only reason why the case is incurable, deep therapy will succeed and the older methods of roentgen-ray treatment will fail. If this fact were always recognized and the treatment planned accordingly, much good could be done in cases that now end only in disappointment. It is equally important to bear in mind that the majority of failures in radiotherapy result from underdosage and this fault is much less likely to obtain with the deep therapy technique. There are undoubtedly a greater number of cases of malignancy which have been arrested or

* Read before Ohio County Medical Society, Wheeling, W. Va., April 9, 1926.

cured by this method which would never have responded to a lower voltage technique.

Unfortunately, the destruction of cancer cells is only one part of the treatment of a cancer patient. If one had only to treat the cancer and not the patient, then the successful treatment of cancer could be reduced to a mathematical formula. Failure to recognize this fact has, in a large measure, been the cause of the disappointment one hears expressed regarding deep therapy. Astonishingly little has been written about the art of administering roentgen-ray treatment, all the emphasis being placed upon the science of accurately administering a certain quantity of rays. This, of course, is very important, as much so as the measuring of a dose of medicine. However, no one speaks of curing an attack of pneumonia with $^{1}/_{60}$ of a grain of strychnine, or 2 drachms of digitalis, although this might literally be the case. To my mind it is just as illogical to say that the roentgen-ray cures cancer as it is to say that strychnine cures pneumonia. In either case, it is the manner in which the case is treated that insures success.

This leads me to the point of a discussion of the two fundamental facts wherein deep therapy technique differs from the older methods. The first fact is that much larger quantities of roentgen rays reach the interior of the body. This result is brought about, first, by using very high voltages to make the rays which increases their penetrating power; second, by placing the tube a greater distance away from the surface of the body so that the difference in proportion between the distance from the tube to the skin surface and the tube and a deep-seated lesion will be less. The strength of rays falls off in proportion to the square of the distance from their source of origin. If the distance from the tube to the skin surface is 10 inches and the lesion is 4 inches beneath the surface, or 14 inches from the tube, then the relative quantity of rays which reach the skin and the deep-seated lesion (ignoring loss by absorption) will be as 10:14, or as 100:196, or about one-half the rays which strike the surface will reach the depth. Now if the tube is moved to a distance of 20 inches from the skin, the lesion still being 4 inches below the surface and now 24 inches from the tube, the proportion will be 20:24, or 400:576, or about two-thirds as much reaches the depth as strikes the surface; third, by the use of thick filters all the low penetrating rays are cut out, the remaining rays being of very high penetration lose very little by absorption in the tissues and, therefore, a higher percentage of the rays striking the surface reach the interior.

The fact that the tube is a long distance from the patient and that the thick filter absorbs a large quantity of the rays makes it necessary to give very long treatments, as only a very small quantity of rays reach the patient. These rays, however, are very penetrating and a large proportion of them go down deep into the patient's body. So far as we know, these high penetrating rays do not destroy cancer cells any better than low penetrating rays, provided the same quantity of low penetrating rays reach the lesion. This condition of affairs, of course, could only occur on the surface of the body and as a matter of fact, we know very well that low penetrating rays are as good as, or better than high penetrating rays in the treatment of epithelioma of the skin. There is one factor which is decidedly different in deep therapy technique and that is the element of time. Ordinarily, these treatments last one and a half to two hours. It is possible that these long treatments have a different effect than a larger quantity of radiation given over a shorter period, although experiments would tend to prove the contrary.

The second fundamental difference in deep therapy technique is that an effort is made to apply a destructive dose to the deep-seated lesion at one time, either literally at one sitting, or by successive treatments so close together that little or nothing is lost in the interval between treatments. This idea was originated with and was sponsored by the Germans who claimed that 120 per cent of the amount of rays which would produce an erythema of the skin would destroy cancer cells. Personally, I have never accepted this hypothesis. This quantity of radiation is delivered to the interior of the body by

delivering fractions of the entire dose through different skin areas, the sum of all the treatments giving the required maximum in the interior. This is an old idea and is known as the cross-fire method.

In order to figure the amount of radiation which reaches the interior, charts are constructed which show the loss of radiation by distance and absorption at any depth below the surface of the body. The patient's contour at the level of his disease is ascertained by molding a flexible metal strip around his body and this contour is transferred to paper and the various organs of the body are drawn in by reference to a life size cross section anatomy chart. The supposed location and extent of the disease is also drawn in on this chart. It is then a simple matter by referring to the absorption chart to find out what percentage of the dose which is applied to the surface reaches the lesion and also the various normal structures around it. By dividing the surface into different areas, one can easily compute how much must be applied to each area so that the sum of all the treatments will be the desired maximum at the lesion. No skin area, of course, should receive a harmful dose. Instruments of precision are available which measure the amount of radiation coming from the tube and must be used to determine when a dose which is the limit of skin tolerance has been given. It is also necessary to know what dose is being applied to the normal structures in the neighborhood of the lesion, such as bowel, bladder, etc. It is sometimes stated that the bowel and bladder will stand 120 per cent of a skin erythema dose without harm. In my experience, a very unpleasant cystitis or proctitis follows the application of 100 per cent of this dose. From observations on several hundred cases of malignancy of the skin (epithelioma), I am convinced that the application of 100 per cent, or even 120 per cent of a skin erythema dose in one treatment will not permanently cure any considerable percentage of these lesions. As a matter of fact, I always apply at least ten times a skin erythema dose to epitheliomata when using the one dose method of treatment. This dose always produces active sloughing and the resulting wound heals up by granulation. This is a very successful method of treating epithelioma, resulting in few recurrences and a high percentage of permanent cures. Such a method, however, is manifestly impossible in any deep-seated lesion which is surrounded by vital normal tissues such as bowel, etc. Referring again to lesions which are so situated that the effect of treatment can be plainly observed, that is, epitheliomata of the skin, we know that the repeated application of sub-erythema doses will often cause their disappearance without any ill effects to surrounding tissues. While this method does not produce as many permanent cures as the single escharotic dose, it is still quite a satisfactory method and is applicable to deep-seated lesions.

With a full knowledge of these facts, I have never attempted to apply 120 per cent or 130 per cent of an erythema dose to such organs as the uterus, bladder, colon, etc., but have sought to cause a regression of the malignancy by the repeated application of doses of such a size as would bear repetition. I was led to adopt this course from very positive convictions gained gradually by daily experience in the treatment of malignancy over a period of several years. I refer first to the fact that epithelioma cannot be cured with any degree of certainty by any simple dose of radiation too small to injure surrounding normal tissues; and second, that in cases of subcutaneous malignancy, if the first dose given is so large that it produces a violent skin reaction and prevents subsequent treatment for a long time, the tumor will advance so much during this period of inaction as to be incurable by radiation treatment. I have made both of these observations so many times that personally I have no doubt that a single dose of radiation that is harmless to normal structures cannot be relied upon to destroy cancer cells in any large percentage of cases and that with our present knowledge our best chance of destroying deep-seated malignancy is by the repetition of a dose which is somewhat less than will cause destruction of normal tissues. I believe this dose should be a trifle less than will cause inflammation in normal tissues and

that it should be repeated as soon as its effect was worn off which is usually in about six weeks. Or, what will possibly prove to be a more satisfactory technique, the administration of the proper fraction of this initial full dose at an interval of three or 4 weeks. This latter is the so-called "saturation method" and I have used it very successfully for some years in the lower voltage technique. To use this method, one needs a chart which shows the percentage of a given dose of radiation remaining in the tissues at any interval between the application and the subsequent date at which all effect of the radiation has disappeared. These calculations were first published by Kingery and lately have been elaborated by Pfahler to apply to modern technique. By this method, the first treatment is slightly less than an erythema dose and when the percentage of radiation remaining in the tissues has become so small that it no longer does any good, another treatment is given of exactly the quantity which has been lost by dissipation from the tissues, thus bringing the effect up to what it was immediately after the first treatment. The rate of dispersion of radiation from the tissues is more rapid immediately after the treatment than later and for that reason probably more than half of the interval which one must allow between two full doses is a period of inactivity, during which there is no beneficial effect. This period of inactivity is eliminated by this method and the amount of radiation in the tissues is kept near the maximum for a great percentage of the time.

This method differs from the old fractional dose method in that the treatment is started with a full dose and subsequent treatments are regulated to exactly replace what is lost so that the effect on the tissues is that of a full dose frequently repeated, but never exceeded. In the old method of frequently repeated small doses there was no beneficial effect until the accumulation reached a point where it could do good. If the treatment was continued in the same manner after that, over-dosage was bound to result as we had no way of estimating the rate of accumulation. This "saturation method" has greatly improved my results with the ordinary 10 inch spark gap technique. Since Pfahler published his charts adapted to 200,000 volt technique, I have tried it in a few cases of that sort also. The result has been a decided improvement, but the method must be used with extreme care as there is little or no leeway for mistakes in measurement of dosage. I have repeated the treatments every four weeks instead of every six or eight weeks as is customary. If a full dose is given at the beginning and the proper percentage at the end of four weeks, a second repetition at the end of another four weeks has been the limit of skin toleration in my hands. The result, however, has certainly been better than anything I have obtained before. I have not used this technique in abdominal or pelvic lesions, but only in malignancies in the neck or about the breast, as the effects can be better watched in these regions.

In a recent effort to form some opinion as to the results obtained with high voltage technique, I have grouped the cases treated as follows:

TABLE I

	Cases	Dead	Improved	Unimproved	Free of Disease	Unknown
Bone lesions	17	8	4	..	3	2
Cervical malignancies	43	25	4	..	11	3
Malignancy of alimentary tract	20	11	3	1	2	3
Breast malignancies	34	15	8	3	6	2
Genito-urinary malignancies	63	28	16	..	15	4
Metastatic glands	7	4	..	1	2	
Total	184	91	35	5	39	14

I shall discuss the treatment of each group in a general way, although it is unnecessary to state that the treatment of different cases in any one group may require modifications to fit the case.

TABLE II

BONE LESIONS

	Cases	Dead	Improved	Unimproved	Free of Disease	Unknown
Sarcoma orbit	1	1				
Glioma brain	1	..	..	..	..	1
Sarcoma superior maxilla	5	3	1	..	1	
Sarcoma bone	6	2	2	..	2	
Carcinoma bone (metastatic)	4	2	1	..	..	1
Total	17	8	4	..	3	2

The case of glioma, of course, does not rightly belong in this group. It is placed here to relieve us of the necessity of creating another grouping for a single case.

When one considers bone malignancy, widely different conditions may confront one. Sarcoma may be either primary or secondary in bone, but carcinoma is always secondary. The presence of carcinoma in bone is always evidence that metastasis has taken place and there is no assurance whatever that the lesion under consideration is the only metastasis. As a matter of fact, the chances are many to one that it is not. For that reason, the outlook in any case of carcinoma of bone is almost certainly a hopeless one, for while the lesion which has been discovered may respond to deep therapy treatment, in the meantime other lesions develop elsewhere until the situation is entirely beyond control.

In sarcoma the lesion may be primary and entirely localized when it is discovered, and as long as it remains so, it is theoretically curable. There are also different degrees of malignancy in sarcoma of bone and those of lesser malignancy I believe can occasionally be cured. I have two cases of spindle cell sarcoma (reported from biopsy by competent pathologists) of the superior maxilla which have now been well, one for six years and one for two years. These were both treated by a combination of radium placed inside the mouth and roentgen rays over the outside. The first case was treated by the 10 inch gap technique, the other with 200,000 volt technique. Of the other cases of sarcoma here reported as free of disease, one was a postoperative case and possibly should not be classed as a result from radiation. The other is a case of sarcoma of the humerus now free from disease for about two years.

Two cases of metastases to the spine secondary to cancer of the breast and one case with extensive involvement of the pelvic bones enjoyed marked relief from pain and although the spine cases succumbed later, they were saved much suffering. The patient with the pelvic bone involvement is going about her daily affairs with no inconvenience two years after the discovery of these lesions, although she could scarcely get about on crutches when treatment was started. The radiation treatment of malignancy of bone is not very encouraging, but unless some other method of treatment offers a better prospect, it should not be withheld in any case, however bad the outlook, as some surprising results are occasionally obtained; and any relief from pain, or prolongation of life thus gained is well worth while.

TABLE III

CERVICAL MALIGNANCIES

		Cases	Dead	Improved	Unimproved	Free of Disease	Unknown
Sarcoma neck—primary		3	2			1	
Teratoma parotid		2		1		1	
Cervical metastases from	Sarcoma nasopharynx	4	2			2	
	Carcinoma lip	6	5			1	
	Carcinoma tongue	8	5	1		1	1
	Carcinoma tonsil	6	2	1		3	
	Carcinoma buccal membrane	5	3			1	1
	Carcinoma alveolar process	8	5	1		1	1
	Sarcoma tongue	1	1				
Total		43	25	4		11	3

Malignancies about the neck, although not very deeply situated, are customarily very resistant to treatment. The principal exception to this is lymphosarcoma which melts away very rapidly under treatment, but is prone to recur and the recurrrence is unaffected by further treatment. This may not be true of the first recurrence, but is almost certain to be the case with some subsequent recurrence. I have not treated a large enough number of these cases by the deep therapy technique to know whether the results will be greatly different from those obtained by the low voltage technique, but the loss of two of the three cases treated would not seem to indicate that it will be. The other type of malignancy of the neck which goes to make up the bulk of the cases of primary tumor which we see is the mixed tumor type. These tumors recur readily after removal and are very resistant to treatment. I have not had much success in treating them either by low voltage roentgen rays, or by the surface application of radium. The two cases treated by deep therapy have responded better and I

believe there will be an improvement in our results by this method.

Malignancy of the cervical lymphatics secondary to a primary lesion in the mouth or throat is an extremely grave complication, usually more difficult of management than the primary condition. For this reason, the neck should always be thoroughly irradiated before any treatment is carried out in the mouth. The treatment of the neck should be the same whether there are any palpable glands or not. I also believe it is wise to irradiate the neck previous to operation if a block dissection is decided upon. I have found the deep therapy technique much more efficacious in the treatment of cervical metastases than low voltage roentgen rays or the radium pack. In a paper read before the American Radium Society in 1924 I reported 50 cases of malignancy of the mouth with metastases to cervical glands, and of this number 8 were cured. Most of these cases were treated before we had deep therapy apparatus. Reference to Table III accompanying this article shows 38 cases of cervical metastases with 9 free from disease. These were all treated with deep therapy technique. This improvement in results is worth while. These cases received a mild erythema dose on the neck before any other treatment was attempted. If there are palpable glands I have lately been giving a second and third treatment at intervals of four weeks, administering the correct percentage of a full dose for this interval according to the charts recently published by Pfahler. It is my belief that traumatism to the original lesion increases the danger of metastasis and for this reason always attempt to treat it with as little injury to the tissues as possible.

In lesions on the lip, I prefer roentgen rays to radium because they can be applied with less traumatism and the results are equally good. However, in using roentgen rays on the lip, an escharotic dose of totally unfiltered rays is necessary. I have described this technique several times before. If radium is used either on the lip or inside the mouth, contact applications are preferable to the insertion of needles or radon seeds because there is less traumatism and also because there is less sloughing with incident infection. The radium can be held in contact with the lesion by fastening it on the end of a piece of sheet lead which is bent so that one end is placed in contact with the lesion and the other end protrudes from the mouth and is bent around the chin or cheek and fastened with adhesive and bandages. In this way the radium can be held in accurate contact with the lesion for a sufficient length of time to destroy it with one dose, which I consider very desirable.

Lesions on the tongue, tonsil or other inaccessible region will have to be treated by the insertion of needles or radon because it is a physical impossibility to make this surface application. While malignancy of the mouth is a very serious condition and cervical metastases make the prognosis much worse, I do not look upon these cases as being utterly hopeless, as I once did. The proper use of radium on the primary lesion will cause its disappearance in a surprising number of cases and I have lately seen cervical glands respond to deep roentgen therapy in a manner that I would not have thought possible a few years ago. Whether these cases remain free from disease or subsequently have a recurrence, time alone will tell.

TABLE IV

MALIGNANCY OF ALIMENTARY TRACT

	Cases	Dead	Improved	Unimproved	Free of Disease	Unknown
Carcinoma esophagus	1	...	...	...	...	1
Carcinoma stomach	2	2				
Carcinoma appendix (P. O.)	1	...	...	...	1	
Carcinoma colon (P. O.)	6	3	1	1	...	1
Malignancy abdomen unknown origin	4	3	...	...	...	1
Carcinoma rectum	6	3	2	...	1	
Total	20	11	3	1	2	3

My results in this group of cases have not been encouraging. In cancer of the esophagus, I have customarily used radium applied to the lesion through the esophagoscope. The only result has been a possible temporary amelioration. None of these cases is reported in the above table, which includes only one case treated by deep therapy. So far as I could tell, the result was not so good as by the use of radium.

In cancer of the stomach, I have not observed any beneficial effect from roentgen therapy.

In carcinoma of the colon, I believe it is proper to use roentgen radiation as a postoperative measure, but never as an alternative to operation if the case is operable. Much good can often be done by resection in these cases and deep therapy may help to prevent recurrence. In the one inoperable case which I have treated, the patient improved for about a year, but after that the mass began to grow again and when last seen the patient was failing rapidly.

Carcinoma of the rectum, if inoperable, may be held in abeyance by a combination of radium and deep therapy for a considerable period. The treatment is more efficacious if preceded by a colostomy. The radium must be placed in actual contact with the lesion to do any good and must be kept in position. This is not always easy, but can usually be accomplished. The rectum does not tolerate radiation well, about twelve hours with 50 milligrams of radium being the maximum. Even with this dosage considerable fibrosis may follow and a stricture result. If there is a colostomy present this will not make much difference, but if not it may become necessary in order to relieve the obstruction. Deep therapy alone does not appeal to me as a logical treatment since radium can be placed at the seat of trouble and when so applied, is usually efficacious. However, roentgen radiation may be used to augment the effect of the radium and to treat extensions or metastases which may be so far away from the radium as to be unaffected by it.

TABLE V

BREAST MALIGNANCIES

		Cases	Dead	Improved	Unimproved	Free of Disease	Unknown
Carcinoma lung (metastatic)		7	5	1	1		
Carcinoma of Breast	Glandular metastases	12	7	3	2		
	Inoperable	8	3	3	..	..	2
	Postoperative (prophylactic)	7	..	1	..	6	
	Total	34	15	8	3	6	2

The treatment of cancer of the breast may be divided into pre-operative, post-operative, inoperable cases and treatment of metastases. Pre-operative treatment is given with two objects in view: (1) To lower the vitality of the cancer cells so that if they should become dislodged during operation, they would be less likely to grow in the region where they had been transplanted; (2) to cause swelling and fibrosis of the lymph channels and thus make it more difficult for metastases to take place. These results are more or less theoretical, but seem to be based on sound logic. The only possible objection to this procedure is that it delays operation for a few days. However, this delay need not be for more than three or four days, especially if deep therapy technique is employed. This technique is preferable because a larger dose can be administered to the entire area at one sitting and the effects are more quickly obtained.

In postoperative prophylactic treatment I do not employ deep therapy routinely over the chest wall because the structures to be treated are very superficial and the normal structures, that is, lung, etc., are situated beneath. For that reason it seems illogical to deliberately attempt to treat the deep (normal) tissues with the least possible effect upon the overlying (diseased) tissues. In pre-operative treatment where there is a large mass in the breast it is necessary to administer the largest dose possible throughout the entire mass, a different situation than after the breast is removed.

Where there are metastases to glands in the supraclavicular region or mediastinum, or to the lungs, and in prophylactic treatment to the supraclavicular region, I use the deep therapy technique. For many years I had considered metastasis to the supraclavicular region an entirely hopeless condition. Recently, however, with high voltage technique, I have seen such glands disappear although it is probable that distant metastases are also present when the case is sufficiently advanced to have enlarged supraclavicular glands, still the control of these glands is a great advance. With further improvements in technique, I expect to see greater improvement in these cases.

Metastasis to the lungs is sooner or later a fatal complication. Some amelioration

can be obtained by deep therapy. I have one case living over two years and now in better health than at the beginning. Caution must be observed not to apply too great a dose to the lungs, as extensive and fatal fibrosis may occur. I never apply more than 90 per cent of a skin erythema dose to any portion of the lungs in one series of treatments. Such a dose can be repeated three or four times at intervals of six to eight weeks.

Cutaneous recurrences in the chest wall after operation respond much better to low voltage rays (7″ gap) with a one millimeter filter than with any other technique that I have used. Recurrences or metastases in the axilla usually have to be treated with radium as the arm cannot be raised enough after operation to apply roentgen rays satisfactorily.

TABLE VI

GENITO-URINARY MALIGNANCIES

		Cases	Dead	Improved	Unimproved	Free of Disease	Unknown
Carcinoma ovary		6	5	...	...	1	
Carcinoma of Uterus	Fundus—X-ray and radium	3	...	1	...	2	
	Cervix—X-ray and radium	16	9	3	...	4	
	P. O.—X-ray and radium	11	6	2	...	2	1
Carcinoma bladder		17	4	7	...	3	3
Carcinoma prostate—X-ray and radium		10	4	3	...	3	
Total		63	28	16	...	15	4

Carcinoma of the ovary is usually a very malignant condition. We have treated these cases by cross-firing the pelvis with high voltage roentgen rays and pushing the treatment as much as possible. However, we have only had one favorable result out of 6 cases.

In carcinoma of the bladder, the treatment differs with the type of disease. In malignant papillomata destruction by fulguration followed by the application of radium against the lesion gives very good results. The radiotherapist seldom sees this type of case which is handled very competently by the urologist. The infiltrating type of cancer of the bladder offers a different problem. Here a large area of the bladder wall is involved and any treatment which includes actual destruction of the lesion is out of the question. Fulguration is obviously impossible; radium is but little better, as a curative dose is also a necrotic dose, and necrosis of a large area of bladder wall is a fatal complication. Deep roentgen therapy applied so as to cause a gradual regression of the lesion would appear to be a more logical form of treatment. The cases reported in Table VI are of this type and treated in this manner. Although permanent cures are not expected, some of our results have been surprising. In practically all of the cases, cessation of pain and hemorrhage and marked improvement in the condition of the patient have made the treatment well worth while.

Carcinoma of the Uterus. At the present time our routine treatment for this disease includes both radium and high voltage roentgen rays. Forty cases treated by radium alone are not included in this report, although a hasty review of them as this paper is being written would indicate about the same proportion of recoveries. The effect of radium on a large ulcerating malignant cervix is often miraculous. The cessation of hemorrhage and foul discharge are a great relief and even in hopeless cases the patient's life is undoubtedly prolonged. In many cases the lesion entirely disappears and in a fair percentage does not return. If there are no metastases I believe epithelioma of the cervix may be cured by radium alone as these lesions seem to be particularly susceptible to radiation. The radium should be well screened and should be so applied that it lies in actual contact with the entire lesion. It must be kept securely in place for the entire length of the treatment which should be long enough to destroy the lesion with one dose if possible. Personally, I prefer contact application to the introduction of needles or radon seeds as the result is equally good and there is not so much sloughing. In carcinoma of the fundus, the radium must be placed in the uterine canal. This type of case is usually considered a better risk by hysterectomy than by irradiation. The beneficial effect of radium does not extend much beyond an inch away from it. Therefore, if the disease extends out into the broad ligaments or involves the pelvic glands, these should be treated by cross-firing the pelvis

by high voltage roentgen rays. Since it is not always possible to know if metastasis has occurred, I now use roentgen radiation as a routine measure, in combination with radium. I do not believe roentgen radiation alone is a logical method of treatment, especially if radium is available, as it is almost everywhere at this time. The amount of relief obtained in cancer of the uterus is not reflected in the percentage of cures. Many cases which eventually die are made comfortable for a considerable period. In fact, there are few cases that are not improved by this treatment.

Cancer of the Prostate. The cases here reported have been treated with radium applied through the urethra on a sound; radium applied against the prostate through several areas in the rectum, and high voltage cross-firing of the pelvis. Marked improvement has followed this line of treatment, 3 out of 10 cases being free of disease. The question of pursuing a more radical plan is one for discussion. Radium needles or seeds may be implanted into the prostate either through the perineum, or by a supra-pubic opening through the bladder. I had one case treated by the latter method who remained well for about a year and died of an intercurrent disease, pneumonia I believe.

Carcinoma of the vulva and carcinoma of the penis are both extremely malignant conditions and when accompanied by metastases to the groin, are practically hopeless. The primary lesions also are particularly difficult to control. I have had no success in treating cancer of the vulva by contact application of radium, or by roentgen radiation. I have had no experience with radon in this condition. Cancer of the penis is also very intractable. I believe the best results are probably obtained by using radium to reduce the lesion as much as possible and then amputating the penis. The glands in the groin should be treated as vigorously as possible with high voltage roentgen rays. The one case reported as free from disease refers to the disappearance of glands in the groin, the original lesion being treated for a time with radium, and the case then referred for amputation.

In conclusion, I believe that the high voltage technique is a decided improvement in the treatment of deep-seated malignancy, or in subcutaneous lesions of large bulk. It is probably more satisfactory because it permits the application of a larger amount of radiation to all parts of a lesion. It will cure only where older methods fail if that failure is due to underdosage. The amount of good done by deep roentgen therapy cannot be judged by the increase in the percentage of cures alone which is probably not very great, but by the amelioration in incurable cases which is much better than anything heretofore accomplished.

TABLE VII

METASTATIC GLANDS

		Cases	Dead	Improved	Unimproved	Free of Disease	Unknown
Metastatic glands groin from	Carcinoma vulva	2	2				
	Carcinoma penis	2	1	..	..	1	
	Moles on leg	3	1	..	1	1	
	Total	7	4	..	1	2	

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: ARTHUR C. CHRISTIE, M.D.

Editorial Board: JAMES T. CASE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

Advisory Board for Pathology: JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

Collaborating Editors: The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL. *Foreign Collaborators:* A. BÉCLÈRE, M.D., PARIS. GÖSTA FORSSELL, M.D., STOCKHOLM. G. F. HAENISCH, M.D., HAMBURG. ROBERT KNOX, M.D., LONDON. R. LEDOUX-LEBARD, M.D., PARIS.

Publishers: PAUL B. HOEBER, INC., NEW YORK

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 1909 Massachusetts Ave., N.W., Washington, D.C. Office of publication, 67-69 East 59th Street, New York.

Information of interest to all readers will be found on page i. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found below.

Officers and Standing Committees

THE AMERICAN ROENTGEN RAY SOCIETY

President: THOMAS A. GROOVER, 1909 Massachusetts Ave., Washington, D. C.; *President-elect:* RUSSELL D. CARMAN, Mayo Clinic, Rochester, Minn.; *First Vice-President:* P. F. BUTLER, Boston, Mass.; *Second Vice-President:* CHARLES RICHARDS, San Jose, Calif.; *Secretary:* CHARLES L. MARTIN, 701 Medical Arts Bldg., Dallas, Texas; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Librarian and Historian:* H. W. DACHTLER, 224 Michigan St., Toledo, Ohio.

Executive Council: H. M. IMBODEN, Chairman, 480 Park Ave., New York City, E. H. SKINNER, Kansas City, Mo., WILLIAM DOUGHTY, Cincinnati, O., THOMAS A. GROOVER, Washington, D. C., RUSSELL D. CARMAN, Rochester, Minn., A. C. CHRISTIE, Washington, D. C., CHARLES L. MARTIN, Dallas, Texas, WILLIAM A. EVANS, Detroit, Mich., RALPH LEONARD, Boston, Mass., RAYMOND C. BEELER, Indianapolis, Ind., ROY A. PAYNE, Portland, Oregon.

Committee on Laws and Public Policy: B. R. KIRKLIN, Chairman, Muncie, Ind., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

Safety Committee: H. K. PANCOAST, Chairman, University Hospital, Philadelphia, Penna., P. M. HICKEY, Ann Arbor, Mich., J. T. MURPHY, Toledo, O., W. D. COOLIDGE, Schenectady, N. Y., WM. DUANE, Boston, Mass., B. H. NICHOLS, Cleveland, O.

Committee on Scientific Exhibit: LAWRENCE REYNOLDS, Chairman, 10 Peterboro St., Detroit, Mich., B. H. NICHOLS, Cleveland, O., M. C. SOSMAN, Boston, Mass.

Publication Committee: H. M. IMBODEN, Chairman, New York City, WILLIAM A. EVANS, Detroit, Mich., E. H. SKINNER, Kansas City, Mo.

Member, National Research Council: P. M. HICKEY, Ann Arbor, Mich.

Member, American Board of Registry of Radiologica Technicians: E. S. BLAINE, Chicago, Ill.

Editor: A. C. CHRISTIE, 1909 Massachusetts Ave., N. W., Washington, D. C.

Editorial Board: JAMES T. CASE, H. K. PANCOAST, WM. DUANE.

Advisory Board for Pathology: JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

Publishers: PAUL B. HOEBER, Inc., 67–69 E. 59th St., New York City.

Twenty-seventh Annual Meeting: Book-Cadillac Hotel, Detroit, Michigan, May 17–21, 1926.

THE AMERICAN RADIUM SOCIETY

President: ALBERT SOILAND, 1407 S. Hope St., Los Angeles, Calif.; *President-Elect:* C. F. BURNAM; Baltimore; *First Vice-President:* BURTON LEE, New York City; *Second Vice-President:* E. H. SKINNER, Kansas City, Mo.; *Secretary:* E. C. ERNST, St. Louis; *Treasurer:* S. M. WITHERS, Denver.

Executive Committee: JAMES T. CASE, Chairman, Detroit; WM. S. NEWCOMET, Philadelphia; DOUGLAS QUICK, New York City.

Program Committee: C. F. BURNAM, Chairman, Baltimore; B. F. SCHREINER, Buffalo; E. C. SAMUEL, New Orleans.

Publication Committee: HENRY SCHMITZ, Chairman, Chicago; E. C. ERNST, St. Louis; H. H. BOWING, Rochester, Minn.

Standardization Committee: G. FAILLA, Chairman, New York City; HENRY J. ULLMANN, Santa Barbara, Calif.; S. M. WITHERS, Denver.

Twelfth Annual Meeting: Washington, D. C.

Committee on Arrangements: TRUMAN ABBE, Chairman, Washington, D. C.; C. AUGUSTUS SIMPSON, Washington; ERNEST N. DORSEY, Washington.

EDITORIALS

EPIPHYSITIS

DURING the past twenty-five years there have been reports from time to time of an affection involving one or more of the epiphyses. Formerly the condition was thought to be of tuberculous, syphilitic, or rachitic origin, but all three of these diseases were gradually excluded and epiphysitis, or osteochondritis, is now accepted as a true disease entity. Among the diseases now classified under this head are the following: (1) osteochondritis deformans juvenilis coxae (Legg-Calvé-Perthes' disease); (2) epiphysitis of the tibial tubercle (Osgood-Schlatter's disease); (3) epiphysitis of the tarsal scaphoid (Köhler's disease); (4) epiphysitis of the head of the second metatarsus (also called Köhler's disease); (5) vertebral epiphysitis; (6) epiphysitis of the os calcis; (7) epiphysitis of the olecranon; (8) epiphysitis of the various epiphyses of the ilium; (9) malacia of the semilunar bone; (10) osteochondritis dissecans of König. It seems probable, in fact, that no epiphysis in the body is immune and that two or more of the epiphyses in quite different parts of the body may be involved in a multiple epiphysitis.

That the condition passing under the various names mentioned above is a pathological entity there now seems little doubt, but there is no general agreement upon the underlying etiology nor even upon the pathological changes that occur. John Poland's description in 1898 of the anatomy of the epiphyses is by far the best work that has ever been published on this subject. A careful study of it is of great value to anyone interested in their development. If supplemented by the work of Cohn on "Normal Bones and Joints" a very thorough knowledge may be gained of the epiphyses of the entire body, their anatomy, the time of beginning ossification, the time of their final junction with the shaft, and their number and relation to the diaphysis. Poland states that, "The epiphyses obtain their blood supply from the periosteal network of arteries, large branches of which perforate the thin layer of compact tissue on their exterior, and are distributed throughout the spongy cancellous tissue. Nearly the whole of the blood supply is therefore independent of the diaphysis. Only one or two minute arteries pass into the epiphyses from the diaphyses through the conjugal cartilage. This accounts for the comparatively infrequent occurrence of necrosis of the epiphysis even when the diaphysis is more or less completely displaced from off the epiphysis." In adult life the epiphyses freely communicate with the diaphysis but before union they are completely shut off from the diaphysis by the epiphyseal cartilage.

The etiology of epiphysitis is obscure. Several writers support the theory of an infectious origin, but a causative organism has been isolated in such a small number of cases that it may be explained on the grounds of coincidence or accidental contamination. The theory of an endocrine origin is little more than an assumption and the idea that the condition is based on some developmental anomaly is no more than a supposition. Some history of trauma may be elicited in a certain percentage of the cases but not in a sufficiently large number to permit it to be looked upon as the ultimate causative factor. Axhausen believes that the pathological picture and the sequence of events proves quite definitely that the condition is not originally a fracture of a healthy bone. He believes that fracture, if it occurs, is secondary to a necrosis of the epiphysis brought about by interrupted or deficient nutrition. Whether trauma is the original cause or only a secondary one, there seems little doubt that chronic injury due to weight-bearing, pressure or muscular pull has a definite place in the production of the flattening, fragmentation, etc., that are characteristic of the disease.

The best known of the conditions classed under the heading of epiphysitis is that commonly known as Legg's or Perthes' disease. Legg described it in February, 1910, Calvé in July, 1910, and Perthes in October, 1910. The best descriptive term is probably osteochondritis deformans juvenilis coxae. It has been mistaken often for tuberculosis of the hip but the roentgen appearance is characteristic and the prognosis is good for complete healing without disability or perceptible deformity.

Separation of the tibial tubercle was reported by Osgood in 1903 and by Schlatter in 1908. There is undoubtedly a true traumatic separation of the tibial tubercle but the true Osgood-Schlatter's disease shows deformities and fragmentation that places it in the same class as Legg's disease.

The two diseases known as Köhler's disease, that of the tarsal scaphoid and that of the head of the second metatarsal bone, are typical examples of osteochondritis. Other epiphyses or developing bones that show the same condition are the os calcis, the olecranon, the ilium and the semilunar. Interest in this condition has been revived in the past few years by Scheuermann's description in 1921 of an affection of the epiphyses of the vertebrae which he called osteochondritis deformans juvenilis dorsi. Other authors have reported the same condition since then and the view is now quite generally held that we are here dealing with the same disease entity represented by Legg's, Perthes' and the other conditions mentioned above. The disease occurs in patients between ten and twenty years of age, that is, during the period of most rapid development of the vertebral epiphyses. The roentgen findings are as follows: The epiphyses of the vertebral bodies which are normally disc-shaped become thickened about the edges, ragged in contour and indistinct in outline. The superior and inferior margins of the bodies are irregular and the joint spaces are cloudy. The condtion should always be suspected in tall, thin children who are round shouldered, whether or not they complain of pain in the back. A localized kyphosis is sometimes present.

Buchman, who made a careful study of vertebral epiphysitis in 1925, believes, as Scheuermann did, that the affection is analogous to Legg's disease in etiology and pathology and also to Osgood-Schlatter's and Köhler's diseases and to the multiple epiphysitis of adolescence. It probably explains the condition called kyphosis dorsalis juvenilis, the so-called schoolchild or muscular kyphosis.

In order that readers of the Journal may have access to the literature on this subject abstracts of all the available articles that have been published during the past few years will be printed in the Journal, beginning with Legg's disease in the June number.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES

WE contemplate the publication of a list of roentgen society meetings such as that below, in each issue of the Journal, gradually adding other home and foreign societies as the information reaches us. Secretaries of societies not here listed are requested to send the necessary information to the editor.

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Charles L. Martin, Dallas, Texas.
Twenty-Seventh annual meeting, Detroit, Mich., May 17–21, 1926.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Washington, D.C., 1927.

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Annual meeting, Milwaukee, Wis., Nov. 29–Dec. 3, 1926.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. Sherwood Moore, St. Louis, Mo.
Annual meeting, Atlanta, Georgia, Nov. 15–18, 1926.

THE CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.
Annual Meeting Victoria, B. C., during week of June 21–25, 1926.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Edward S. Blaine, 5 S. Wabash Ave.
Meets monthly on second Friday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. E. P. McNamee.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. Henry L. Ulbrich, 1130 E. Grand Blvd.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

THE NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Charles W. Blackett, 35 Bay State, Rd., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Eugene V. Powell, 217 East 42d St.
Meets monthly on second Monday, New York Academy of Medicine.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.
Meets in Victoria, B. C., during week of June 21–25, 1926.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. S. C. Davidson, Highland Hospital.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Davis Spangler, Dallas, Texas.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.
Meets at Dunedin, New Zealand, during February, 1927.

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

THE BRITISH RONTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London; W. 1.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prag, 11/52.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Torino, Torino.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medcine, 1 Wimpole St., London, W. 1.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Meets in Copenhagen.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

NEW YORK ROENTGEN SOCIETY

The one hundredth meeting of the New York Roentgen Society was held Monday, April 12, at the New York Academy of Medicine. Dr. R. W. Westbrook of Brooklyn, presented a paper entitled "Personal Observations on the Results Obtained by Dr. Blair Bell in the Treatment of Cancer with Lead Compounds." Dr. Westbrook had spent some time in Liverpool, having taken a patient there to undergo treatment with lead.

Blair Bell had been interested in cancer for a number of years. In considering the matter he reasoned that the cells of the chorionic villi in pregnancy had many of the characteristics of malignancy in that they multiplied rapidly in pregnancy and then ceased growing. He at first ascribed the cessation of growth to some substance in the fetus. Later he observed that many of the women engaged in pottery manufacture in Liverpool aborted, and he ascribed these abortions to the lead used in making pottery. Recent but incomplete statistical data gathered in the vicinity of Liverpool seems to point to a reduced incidence of cancer in lead workers. He then began to use lead experimentally in cancer in animal experimentation. Lead in colloid form made up with gelatin and finely divided metallic lead is injected intravenously. The dosage is 0.1 gm. of metallic lead. This is repeated at intervals until about 0.6 gm. has been given. It is very important to examine the blood and urine before treatment, as nephritis contraindicates the use of lead. The blood and urine are carefully studied during the treatment for evidence of toxic effects. Stippling of the red cells is the most important evidence of toxicity. If one or more stippled cells are observed in each field, or if albumin appears in the urine, the treatment is temporarily discontinued. Despite the most careful observations there have been some fatalities from acute lead poisoning.

This treatment has been more successful in sarcoma than carcinoma and in general the results have been most satisfactory in the more vascular tumors. The results in cancer of the mouth and also in metastatic lesions have not been favorable. Apparent cures observed by the author of the paper were inoperable cancer of the breast and axilla; of the esophagus; and of the rectum; and sarcomata of the bones, ovaries and intestinal tract.

Blair Bell has never published a definite formula of his preparation, and excuses this lapse by saying that a stable preparation has not yet been perfected. Surgery is often used to remove as much of the tumor as possible before administering lead. Roentgen radiation is also employed, and seems to be more effective in cases in which lead has been used, possibly due to secondary rays from lead in the tissues. Dr. Westbrook was of the opinion that lead would effect a clinical cure in a certain percentage of cases of cancer not amenable to other forms of treatment.

Dr. Francis Carter Wood of New York opened the discussion. Dr. Wood had also

visited Liverpool and agreed in general with Dr. Westbrook's observations on the results of this treatment. As a pathologist he had studied the slides in many of the cases reported as cures and agreed with the diagnoses made before beginning treatment. He also showed slides demonstrating the effect of lead intravenously administered to healthy and tumor-bearing mice. Sections from the liver of healthy mice after the use of lead showed areas of necrosis with thrombi in many of the vessels. Slides from tumors in mice subjected to lead treatment showed central necrosis of the tumor with less marked changes in the periphery. In order to effect changes in the tumors of mice it was necessary to give doses, which in a certain percentage proved to be lethal. Dr. Wood believed this to be true also in the treatment of human cancer and that therefore there would be a certain primary mortality from lead poisoning in these cases. He also stated that this work was not original with Blair Bell as German investigators had, a number of years ago, reported experimental work with lead and other metals in malignant disease. He reported that preparation of the colloid lead had been successfully carried out and that it was now being used in some institutions in this country.

Dr. Westbrook closed the discussion and in his closing responded to inquiries of various members of the Society concerning various details of the treatment.

Eugene Powell, M.D.,
Secretary.

SECTION ON RADIOLOGY AMERICAN MEDICAL ASSOCIATION

The Section on Radiology, American Medical Association, held three sessions this year at the meeting of the Association at Dallas, Texas, on April 21, 22 and 23, 1926. The chairman, Dr. A. C. Christie of Washington, presided. Dr. H. M. Imboden of New York was vice-chairman and Dr. M. J. Hubeny of Chicago, secretary. An excellent program was provided at every session and there was interested and spirited discussion. The papers will be published in the Journal of the American Medical Association.

The officers elected for the coming year were as follows: Chairman, Albert Soiland, Los Angeles; Vice-Chairman, E. C. Samuel, New Orleans; Secretary, Fred M. Hodges, Richmond; Section Delegate to the House of Delegates, James T. Case; Alternate, E. H. Skinner.

The Section on Radiology is now a fully established organization of the American Medical Association. It finally gives to roentgenologists the official recognition of the American Medical Association and recognizes roentgenology as an integral part of medicine. We may expect many and far-reaching beneficial results from this recognition. The Section deserves and should have the support of every member of the American Medical Association who claims radiology as his specialty.

AMERICAN RADIUM SOCIETY

At the annual meeting of the American Radium Society held at Dallas, Texas, on April 19 and 20, 1926, the following officers were elected for the coming year: President-elect, Curtis Burnam, Baltimore; First Vice-President, Burton J. Lee, New York City; Second Vice-President, E. H. Skinner, Kansas City; Treasurer, Sanford Withers, Denver; Secretary, E. C. Ernst, St. Louis.

AMERICAN COLLEGE OF RADIOLOGY

At the annual meeting of the American College of Radiology held at Dallas, Texas, April 21, 1926, the following officers were elected for the coming year: President-elect, M. J. Hubeny, Chicago; Vice-President, H. M. Imboden, New York City; Treasurer, B. H. Orndoff, Chicago; Historian, I. S. Trostler, Chicago; Executive Secretary, Albert Soiland, Los Angeles. Dr. P. M. Hickey of Ann Arbor is the president of the College of Radiology.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

GRAPHICAL METHODS OF CALCULATION IN RADIUM THERAPY

BY DONALD S. PISTON

Department of Physics, University of Maine

ORONO, MAINE

DURING some recent work in the field of radiology, it came to the notice of the author that the laws of decay of radioactive preparations, while of comparative simplicity to mathematicians and physicists, are of great complexity to most medical men, whose mathematical equipment is necessarily limited. It seemed that the simplest and most reliable way of making calculations based on these laws would be by means of some kind of chart, from which the required information could be read off without necessitating any knowledge of the laws themselves or of the various arithmetical processes by which the results are obtained. These requirements are met by the type of chart called the alignment chart, or nomogram, of which the accompanying figures are examples.

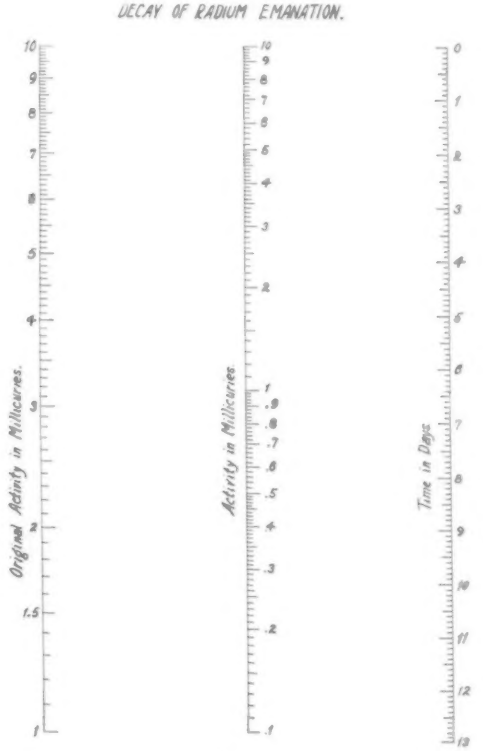


FIG. 1.

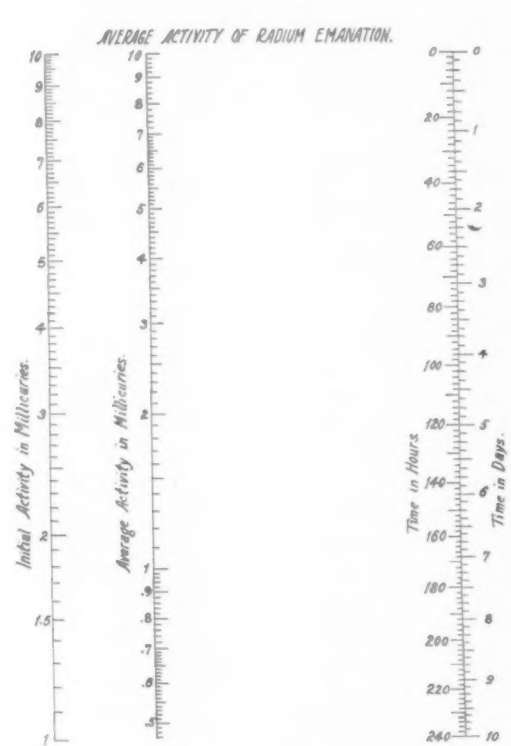


FIG. 2.

Figure 1 shows such a chart for calculating the strength of an emanation tube after a given number of days. To illustrate the use of this chart, let us consider a numerical example. Suppose that it is desired to find the strength of a 6-millicurie tube after two days. On the scale marked

"original activity in millicuries" find the point 6, and on the scale marked "time in days" find the point 2. Now lay a straight-edge across the chart so as to connect these two points. The reading on the center scale, marked "activity in millicuries," at the point where the scale is cut by the straight-edge, gives the answer. In this case the reading is 4.2 mc.

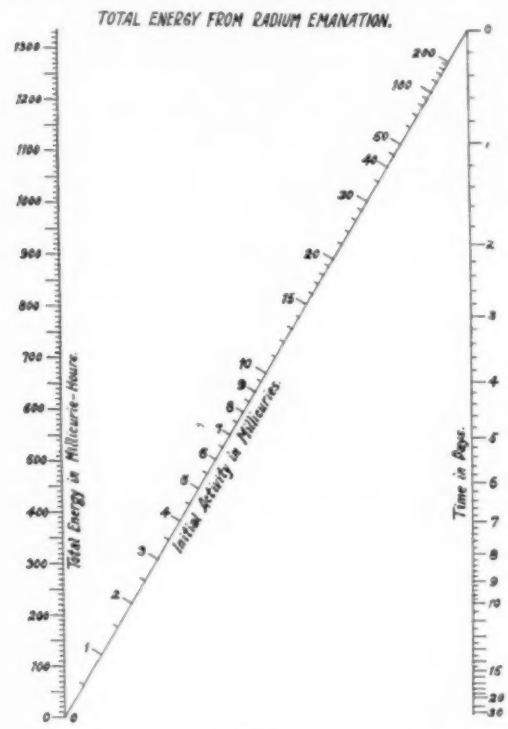


FIG. 3.

quantities to plot instead of three, as in the previous cases, so that the chart will not be so simple. The known, or measured, quantities are the time of discharge of the electroscope by the standard (a tube containing a known quantity of radium), the time of discharge by the specimen,

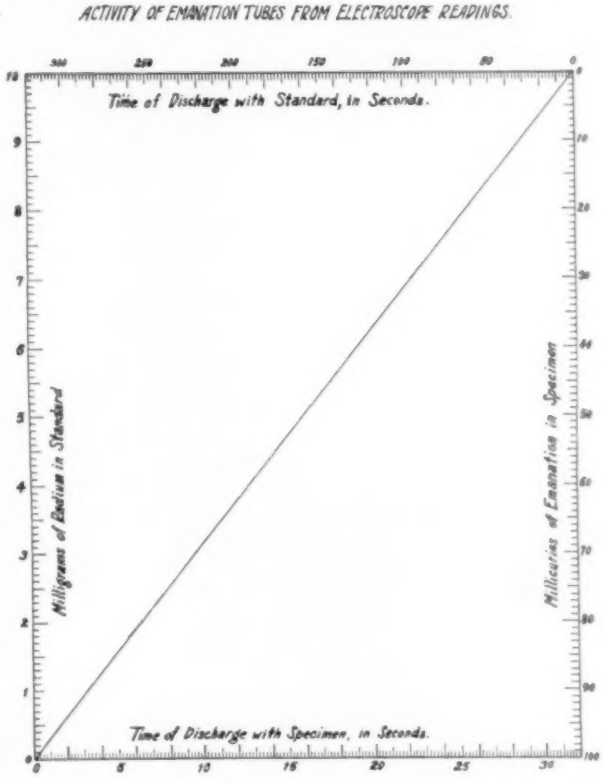

ACTIVITY OF EMANATION TUBES FROM ELECTROSCOPE READINGS.
Time of Discharge with Standard, in Seconds.
Milligrams of Radium in Standard
Millicuries of Emanation in Specimen
Time of Discharge with Specimen, in Seconds.

FIG. 4.

Figure 2 is a chart for finding the average activity of an emanation tube over a given period of time. The mode of operation is exactly the same as for Figure 1.

Figure 3 is a chart for finding the total energy, or the dosage, in millicurie-hours. In this case, it is necessary to find the original strength of the tube on the diagonal scale, and the time in days on the right hand vertical scale. A straight-edge laid across the chart so as to connect these two points intersects the left hand vertical scale at the point corresponding to the number of millicurie-hours.

Figure 4 is a chart to be used when the gamma ray activity of an emanation tube is measured by means of an electroscope in the usual way. In this case there are four

and the number of milligrams of radium in the standard. From these the number of millicuries of emanation in the specimen is to be found. The procedure is as follows: Connect by a straight-edge the time of discharge by the emanation and the time of discharge by the standard, and note the point where the straight-edge cuts the diagonal. Connect this point in turn with the number of milligrams of radium in the standard on the left hand vertical scale, and the point where the straight-edge cuts the right hand scale gives the number of millicuries of emanation in the specimen.

The result found from Figure 4, however, will not be sufficiently precise when the leak of the electroscope is appreciable. For this reason Figure 5 is appended. The procedure

is to find the corrected time of discharge from Figure 5, and then to use this corrected time in Figure 4. Figure 5 is read by means of a straight-edge like the others.

As it is not feasible to give an adequate explanation of the design and construction of these charts in this article, the interested reader is referred to any of the numerous books on the subject. The most complete treatment is M. d'Ocagne's "Traite de Nomographie." A very full discussion is given in Joseph Lipka's "Graphical and Mechanical Computation." Another good book is J. B. Peddle's "Construction of Graphical Charts."

The value of graphical charts as labor saving devices has long been recognized by engineers, but their usefulness in other professions is not so well appreciated. It is hoped that these examples will be of some help to medical men and radium workers generally.

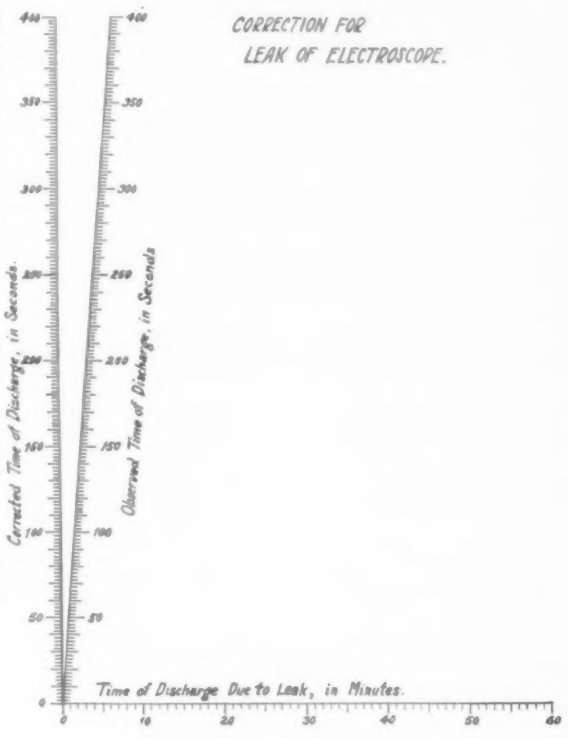


FIG. 5.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THOMAS SYDENHAM, CLINICIAN. By David Riesman, M.D., Professor of Clinical Medicine, University of Pennsylvania. Cloth. Price, $1.50. Pp. 52. New York: 1926, Paul B. Hoeber, Inc.

This little book is not a formal biography but an essay on the great Sydenham and his relation to clinical medicine. The author rightly gives him his place as the real founder of modern medicine. Up to the time of Sydenham the practice of medicine was based upon the philosophy of Aristotle and the theories of Galen and the Arabians. The basis for treatment of disease was found in metaphysical speculation. Sydenham rescued it from this quagmire and placed it upon the sound foundation of accurate observation, and changed the entire medical language from a metaphysical jargon to that of the man of science.

In these days when diagnosis is so frequently based upon laboratory findings, which are too often poorly studied and incomplete, and upon opinions of laboratory men who may never have seen the patient at all, a book such as this serves a most excellent purpose. No one can read of Sydenham and his methods and the great impetus he gave to the progress of medicine without realizing that the fundamental equipment of the real physician is his ability as a clinical observer.

It is not too much to say that the usefulness of laboratory findings and of the evidence brought forth by the roentgen ray is in direct proportion to the care with which they are correlated with the evidence elicited by accurate clinical examination. Sydenham knew nothing of laboratories and he died more than two hundred years before the discovery of the roentgen ray, but it is true today as it was in his day that nothing can take the place in medicine of careful clinical observation.

A. C. C.

CHRONIC INFECTION OF THE JAWS: A Short Radiological and Clinical Study. By Stanley Colyer, M.D. (Lond.), M.R.C.P., D.M.R.E. Radiologist, Mildmay Mission Hospital; Late Assistant Radiologist, Royal Dental Hospital. Cloth. Pp. 75, with 26 illustrations. London: H. K. Lewis & Co., Ltd., 1926.

The book opens with a short preface in which the author states that its object is to draw attention to the importance of the relation of oral sepsis and systemic disease, and "to show how radiology may be used in diagnosing chronic infections of the jaws." In chapter one the prevalence of jaw infections is emphasized, and the following chapters are taken up with a description and illustrations of the roentgenographic appearance of normal teeth and jaws and the roentgenographic changes which the author regards as signs of jaw infection.

The book is written in a clear and entertaining manner, but its scientific value is marred by the fact that it is full of assumptions and opinions, not supported by sufficient evidence. For instance, it is not clear how the conclusion is reached that the bone changes which take place in orthodontic treatment are due to infection. When teeth are moved from one position to another, it is obvious that bone changes must occur, but it remains to be proved that these changes are pathological. Even in cases of resorption of the root ends, which the author mentions, the probability of an infective process can be ruled out when the pulps of the affected teeth are vital, which is often the case.

The author also assumes that the condition known as condensing osteitis or sclerosis is always pathological or one of the results of an infective process, and does not seem to recognize the work of McMillan and others who have shown that these changes are often functional, and an effort on the part of nature to meet stress requirements. This condition is often seen in the denser cancellation about a single molar which bears the brunt of mastication.

The book contains many good points and is to be recommended to the practitioners of medicine and dentistry who have sufficient experience to sift the t uth from the mass of opinions and theories with which it abounds.

L. M. CHRISTIE, D.D.S.

AMERICAN ANNUAL OF PHOTOGRAPHY, 1926. Edited by Percy Y. Howe. Paper. Price, $1.75. Cloth Price, $2.50. New York: The American Annual of Photography, Inc., 1925. Sales Agents, George Murphy, Inc., 57 East 9th St., New York City.

For the camera enthusiast the American Annual of Photography is as indispensable as a journal of medicine is to the doctor.

In the 40th annual issue, a comprehensive aggregation of interesting subjects is intelligently presented. Among the 150 or more

illustrations are many which appeal by their artistic merit as well as establish a goal to be attained by the pictoralist.

E. A. MERRITT, M.D.

BOOKS RECEIVED

CHRONIC INFECTION OF THE JAWS: A Short Radiological and Clinical Study. By Stanley Colyer, M.D. (Lond.), M.R.C.P., D.M.R.E. Radiologist, Mildmay Mission Hospital; Late Assistant Radiologist, Royal Dental Hospital. Cloth. Pp. 75, with 26 illustrations. London: H. K. Lewis & Co. Ltd., 1926.

RADIOGRAPHY: A Manual of *X*-ray Technique, Interpretation and Therapy. By Charles D. Enfield, M.D., F.A.C.P., Roentgenologist to St. Anthony's Hospital and Norton Memorial Infirmary, Louisville, Ky. Cloth. Price, $10.00. Pp. 299, with 194 illustrations. Philadelphia: P. Blakiston's Son & Co., 1925.

RÖNTGENBEHANDLUNG CHIRURGISCHER KRANKHEITEN ZUGLEICH EINFÜHRUNG IN DIE PHYSIKALISCHEN UND BIOLOGISCHEN GRUNDLAGEN DER RÖNTGENTHERAPIE. By Professor Dr. Otto Jüngling, Oberarzt der Chirurgischen Universitätsklinik, Tübingen. Paper, Price, 20 Marks. Cloth. Price, 22 Marks. Pp. 468, with 86 text figures and one plate. Leipzig: S. Hirzel, 1924.

WILLIAM CADOGAN (His Essay on Gout). By John Ruhräh, M.D., Professor of Diseases of Children, University of Maryland. Cloth. Price, $1.50. Pp. 114. New York: Paul B. Hoeber, Inc., 1925.

THOMAS SYDENHAM, CLINICIAN. By David Riesman, M.D., Professor of Clinical Medicine, University of Pennsylvania. Cloth. Price, $1.50. Pp. 52. New York: Paul B. Hoeber, Inc., 1926.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

ABT, I. A. Massive collapse of the lung. *Am. J. Dis. Child.*, September, 1925, xxx, 347–354.

A brief review of the literature is given, and a detailed report is presented of a case occurring in a boy aged ten. The onset was sudden with pain definitely localized in the right iliac region. It is worthy of note that the patient had been well throughout the preceding winter and had had no acute respiratory infection, nor earache previous to the onset of this illness. An appendectomy was performed, and on the second day after the operation there was a definite change in the child's condition. He was dyspneic, cyanotic and had a painful cough. The right side of the chest appeared immobile. The roentgenogram of the lung at this time showed that the diaphragm was placed unusually high, extending to the fourth rib anteriorly, thus diminishing the capacity of the thorax. The heart was situated medially, though more to the right than the left. There was no evidence of pleural effusion nor of lung consolidation. The patient recovered from postoperative complications and was discharged cured.

It is important to recognize massive collapse of the lung and make the correct diagnosis in order to avoid misdirected treatment. Thoracentesis on either the diseased or other side could produce pneumothorax which might cause untoward symptoms or even a fatal issue. The prognosis is almost invariably good, except in patients with bilateral collapse and who in addition are debilitated.

ACHARD, CH., and THIERS, J. Vacuolated osteofibrosa (osteopathy of Recklinghausen). *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3 s., xli, 1019–1024.

The roentgenogram is of first importance in establishing diagnosis in osteopathy of Recklinghausen. In a case, which is reported here in detail, such diagnosis was made only by means of the roentgenogram, because the clinical symptoms were of such a nature as to be extremely puzzling. The patient was subject to promiscuous vomiting at more or less irregular intervals, certainly at times which precluded any relation to diet or time of eating. Pains in the gastric region, with cramps and constriction accompanied these distressing symptoms. There was slight ptosis of the left upper eyelid and limitation of the movements of the eyeball. Wassermann reaction was positive. A roentgenogram of the left leg showed, on the internal side near the crest of the tibia, a protrusion of the nature of an exostosis, as large as a nut and absolutely painless. A similar outgrowth was also found on the sternum, on the external part of the manubrium, as well as on the right tibia also. The roentgenograms showed clearly that these formations were not due to vacuolated formations. This is an entirely different disease known as osteopsathyrosis, and is found mostly in young people. The osseous tissue in such cases is paler in the roentgenograms than is normal bone. Without a roentgenogram there would naturally be considerable confusion as to the nature of such lesions. With histologic study, it constitutes the most exact means of diagnosing this condition. The term "vacuolated osteo-fibrosa" indicates fibrous transformation of the marrow and vacuolation of the bone.

ANDERSON, C. C. The *x*-ray examination of the gall-bladder. *New Zealand M. J.*, August, 1925, xxiv, 201–209.

It seems almost assured that the mere demonstration of a gall-bladder shadow by the ordinary technique is sufficient for a diagnosis of pathological gall-bladder. In those cases where this is negative the Graham test is valuable.

The experience with the Graham test at the Dunedin Hospital, New Zealand, confirms the claims of Graham and his co-workers.

For the demonstration of abnormal shadows of the biliary apparatus the posteroanterior or ventral plate is sufficient, but it is advisable for the purpose of differentiating renal shadows to take an anteroposterior plate also. The roentgenological evidence of pathological or calculous gall-bladder is as follows: *Direct Evidence:* (1) shadow of stones, opaque and solid shadows, ring shaped shadows, mosaic shadow due to overlapping; (2) shadow of gall-bladder. *Indirect Evidence;* (1) pressure effects on duodenum and pyloric part of stomach; (2) traction effects; (*a*) pouching of duodenum, (*b*) displacements of duodenum, (*c*) displacements of colon, and (*d*) fixity of duodenum and of colon.

Of 101 patients examined, direct evidence was obtained in 20; and the diagnosis was confirmed in 9 out of 11 operated upon. In a further group of 33 cases, the gall-bladder shadow was demonstrable, and in 14 out of 16 of these operation confirmed the diagnosis.

A uniform technique and plates of first-class quality are essential. The roentgenographic

examination of the pathological gall-bladder is justifiable and desirable in view of the percentage of results obtained. A negative finding is of no great value at present, as many pathological gall-bladders are not distended; but the diagnosis should be cleared up in a large number of cases of this class by further examination by the Graham method.

ATTINGER, E. The roentgen examination of the bulbus duodeni by the method of the thin layer. *Schweizer. med. Wchnschr.*, Sept. 10, 1925, lv, 841–844.

Akerlund has described a method of examination which he describes as "the direct compression over the bulbus." This technique is called by the author the "method of the thin layer," as opposed to the method of examination making use of repeated filling of the bulbus. This method has no applicability for determining outlines, but brings forward with distinctness the surface markings. The contents of the bulbus are largely squeezed out so that the surface details become visible. At the same time the contrast mass is squeezed into niches and diverticula. This method is regarded by the author as an essential part of the technique of duodenal examination. The method is as follows: The previously filled bulbus is compressed with the hand or distinctor slowly and progressively until in each case only a very thin layer of contrast material remains. Often the compression is maintained until all the contrast material has been squeezed out to reveal the presence of any abnormal depressions.

Descriptions and sketches are given of the observations in 2 cases where this method of diagnosis revealed many details, subsequently confirmed at operation.

BAUM, FELIX, AND BLACK, LOUISA T. The importance of the apical roentgenogram in pulmonary tuberculosis. *Am. Rev. Tuberc.*, November, 1925, xii, 228–229.

In the early roentgen diagnosis of apical pulmonary tuberculosis the general plate in many cases does not show the details in the apical region, owing to the fact that the clavicle obstructs the view by covering parts of one or more intercostal spaces. The authors have tried the Albers-Schönberg technique but have found that the interspaces are not seen as clearly nor do they appear as large as when the rays are directed from the opposite side.

As a result the following technique has been devised: The patient lies recumbent on a horizontal table and rests against a wooden pillow built at an angle of 50°. On this incline is placed a feather pillow to prevent the cassette from slipping. This makes the incline about 60°. The patient is instructed to press lightly on the table with the elbows or hands so as to raise the ends of the clavicle. The roentgen tube is placed at an angle of 20° and is focused on the sternum where the latter articulates with the clavicles. All apical examinations are made on 8 by 10 duplitized films, with double intensifying screens, 88 kv., 60 ma., and at a distance of 29 in. The time of exposure is governed by the size of the patient (usually about ¼ sec.).

The advantages of this method are: (1) the clavicle is projected above the first rib and does not obstruct the view, and (2) the first, second and third interspaces can be seen in their entirety. Apical plates are important in cases where thoracoplasty is recommended and active tuberculosis in the so-called "good" lung has to be excluded.

BELOT, BOQUET AND LEPENNETIER, F. Roentgenologic images of the spleen, difficulties of diagnosis. *Bull. et mém. Soc. de radiol. méd. de France, Par.*, 1925, xiii, 27–29.

The visibility of the spleen in roentgenograms is well known, but there are several factors which cause certain difficulties in observations. Increase in size of the spleen is easily noted, of course, in which case the diagnosis is simple. It is often difficult to distinguish an abdominal tumor under certain circumstances, when recognition of the spleen becomes more difficult when the tumor is large. Hydronephrosis of the kidney is also another complicating factor. Such factors must be considered when examining roentgenograms of the spleen.

BISCHOFF, L. The roentgenologic demonstration of the pathological (enlarged) gall-bladder. *Schweizer. med. Wchnschr.*, Aug. 6, 1925, lv, 731–732.

The roentgenologic demonstration of the gall-bladder is dependent upon a perfected technique. Recent advances in this technique have been made by Graham. It is suggested that apart from ingenuity, material resources have had a good deal to do in this progress since experiments in this field have been very expensive. Moreover, ten to twenty plates are recommended for the roentgen examination of a single gall-bladder by the Graham method.

The technique employed by the author makes use of air insufflation of the rectum. The bowel of the patient is cleared by mild laxative and the next morning receives a large enema. Roentgenograms are taken with the patient in the prone position and laterally

with the upper part of the body raised slightly. The patient then receives while upright and in prone position a rectal injection of air. There is no preferred position for the gall-bladder roentgenogram because this position varies. The air injection is continued when possible until the well adapted eye can recognize the lifting of the right flexure and the transverse colon from the lower margin of the liver. By this time the patient will usually complain of a painful feeling of tension. At the right moment an instantaneous roentgenogram is taken. The cassette is placed above and in front and pressed forward upon the distended abdomen. An example of a good roentgenogram taken by this method is given.

Bouchut, L. Roentgenoscopy of the colon and colonic ptosis. *J. de med. de Lyon*, 1925, xvi, 407–414.

A series of 100 subjects without indications of intestinal troubles were selected for roentgenoscopic study of the colon. In the same subject at different times over a period of weeks the roentgenoscopic picture is different. There were no clinical symptoms nor abnormal consequences resulting from such changes in position of the colon. The condition of ptosis is much more common in normal than in abnormal colon. Colonic ptosis does not necessarily imply clinical disturbance of the organism; it is not a diseased condition. It is congenital in many subjects; in others it most often accompanies excessive emaciation. Ptosis does not necessarily accompany constipation; when these are coexistent, they usually have the same origin, insufficient quantity or quality of food. Many diagrams are given to illustrate the position of the colon in various subjects and types of condition.

Breuer, Roland G. Mediastinal and lung tuberculosis. *J. Radiology*, August, 1925, vi, 307–311.

An incipient case of pulmonary tuberculosis cannot be diagnosed by means of percussion and auscultation. When a diagnosis of pulmonary tuberculosis can be made by these means, the disease is moderately advanced and is no longer incipient.

Percussion and auscultation of the lungs depend upon the density of the reacting inflammatory tissue as well as upon the density and rarefaction of the natural tissues intervening between the lesion in the lung and the surface of the chest wall.

The roentgenogram of the lungs is second in importance only to the complete history and should take precedence over physical findings in early cases. There is a striking uniformity in the pattern of fibrosis in all the chest plates of a family series of tuberculous patients. The roentgenogram shows a progression of the infection and protective fibrosis year by year as the older members of the family are examined. This fibrosis is shown as always beginning in the hilum in the infants and children and spreading peripherally and radially into the lung parenchyma in the older members of the family. These characters are illustrated in one series.

Cathcart, John W. Roentgen diagnosis of pulmonary tuberculosis. *Texas State J. M., Fort Worth*, October, 1925, xxi, 379–382.

The first essential in a roentgen study of the chest after the roentgenoscopic observation which reveals limitation of motion, decrease of elevation, changing fluid levels and gross structural changes, is a set of soft stereoscopic roentgen films made perferably with the patient in the vertical position, with an up and down shift of the tube, with a milliamperage of 100 to 300, distance 3 to 4 ft., exposure not greater than 0.1 sec.

A precise knowledge of the normal lung structure is presupposed. In the tuberculous lung surrounding the tubercle there will be a serous or cellular exudate which, when present in quantity, will appear on the film as a small nebulous shadow. The increased congestion will cause lymph stoppage and will result in increased density of the involved branch of the bronchial tree. The picture will then show in the place of the previous small nebulous shadow at the periphery of the thickened bronchial branch, a sharply defined, fibrous bead and an almost normal bronchial tree. Since a large number of alveoli in a lobule are usually involved at one time, a triangular shaped area will be seen with its base at the pleura, apex at the hilus, filled with sufficient nebulous bodies to give a smoky or cottony appearance. The bronchial tree branches will appear heavy and interlacing. This condition will be translated as active tuberculosis or, as some prefer to call it, a recent tuberculosis.

Should the tuberculosis undergo resolution and fibrosis the roentgenogram would show numerous, small, sharply defined, discrete shadows (beading). These are interpreted as scar tissue of a healed tuberculosis.

If the tuberculosis undergoes caseation, instead of fibrosis the field is seen invaded by pyogenic organisms, the delicate shadows of the pure tuberculous infection are changed to a heavy diffuse shadow, smoky in appearance. This process may become arrested and there will then be very heavy, sharply defined shadows, frequently spoken of as "mottled,"

with a marked decrease in the air-containing capacity of that portion of the lung. This constitutes the fibroid type of tuberculosis.

If, instead of becoming fibroid the process continues, the entire lobule may break down and discharge through the bronchus, the parietal pleura surrounding the lobule becoming heavily infiltrated and thickened, producing the circular shadows which are designated as cavities. The latter may be multiple and small, or confluent, and may or may not contain fluid. The difficulty in diagnosis is not in the typical and clean-cut cases but in the atypical and complicated ones. These furnish pitfalls that can be overcome only by sufficient experience and training.

CIPRIANI, FRANCESCO. Talodynia. *Ann. ital. di chir.*, Aug. 20, 1925, iv, 727–749.

The name talodynia means a painful affection of the lower surface of the calcaneum, the nature and cause of which are still under discussion. It generally occurs in adults from twenty to forty years of age, though Blum has described two cases in patients of fifty-five and sixty; the great majority of the patients are men, and most of the cases are in individuals who have to stand on their feet or walk a great deal. Cipriani gives the case histories and roentgenograms of 4 cases. All of them had intense, stabbing pain in the bottom of the heel, like that caused by a nail in the sole of the shoe. The pain stopped on rest, but reappeared on walking and it could also be produced by pressure with the finger on the plantar surface of the heel at the site of the postero-internal tuberosity of the calcaneum. In two of these cases there were exostoses but in the other two there were not. The pain is sharper and more lancinating in the cases with exostosis and is limited strictly to the site of the exostosis, while in the other cases it extends over the whole lower surface of the heel. Not all exostoses are painful however; in the second of the author's cases there were multiple bilateral exostoses some of which were painful and some were not; the retrocalcaneal ones never caused pain. The age of these patients and their good general condition excluded the possibility of arteriosclerosis and neither of them had flatfoot, tabes, arthritis deformans or a history of any considerable trauma, all of which have been suggested as causes of talodynia. But both of them had a history of gonorrhea and many authors have given this as a cause of exostoses. The fact that gonorrhea is so frequent and exostoses relatively rare does not argue against this theory as there are other manifestations of gonorrhea which are relatively rare, such as gonorrheal arthritis, endocarditis, etc.

The other two patients did not have exostoses, but the postero-internal tuberosity was unusually developed and extended downward like a spur. With a tuberosity like this the repeated trauma on walking a great deal may cause talodynia which in these cases can usually be cured by rest and hot foot-baths and placing a ring of felt or other soft substance under the tuberosity. In cases with exostosis it may be necessary to remove the exostoses surgically.

COLE, LEWIS GREGORY. *X*-ray kinks or angulations of ureters, that are not kinks. *Am. J. Surg., Elmira, N. Y.*, May, 1925, xxxix, 107–108.

Attention is directed to the fact that the shadow of a ureter having a gentle curve may appear on the roentgenogram as a kinked ureter if the roentgen plate is placed perpendicularly to the plane of the curve.

COYON, AM., MARTY, P., and AIME, P. A case of bronchial dilatation with sinistrocardia and deviation of the trachea. (Injection of lipiodol.) *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3 s., xli, 1061–1065.

Roentgenograms after lipiodol injection, in the case reported, showed clearly dilatation of the bronchioles and definite displacement of the heart to the left, with consequent displacement of the trachea. The illustrations submitted show these changes quite distinctly. It is evident that these conditions could not be so clearly diagnosed in any other way.

DAVIS, FREDERICK A. Tower skull oxycephalus. *Am. J. Ophth., Chicago*, July, 1925, viii, 513–541.

An attempt is made to define more completely the clinical condition known as tower skull. Six cases are reported from the Department of Ophthalmology of the University of Wisconsin with fairly complete and detailed histories, symptoms and general physical findings. The condition is more common than recorded cases might indicate. It must frequently pass unrecognized, especially in the early stages when treatment would be most effective. To remove confusion with other skull deformities, a case of congenital idiocy is reported for contrast. Tower skull has been incorrectly ascribed to rickets and meningitis, but seems to be essentially a fault of development.

Exophthalmos is the most common physical finding observed in this disease. The exophthalmos varies from mild degree to extreme proptosis and practical extrusion of the globe.

The symptoms of exophthalmic goiter are not seen. The exophthalmos is due to very shallow orbits.

The roentgen findings are among the most interesting changes found and form one of the striking and important points in the diagnosis. The more typical roentgenographic findings show thinning of the skull, together with depressions and ridges, the so-called digital impressions. These are seen over a large portion of the cortex, often throughout. The skull appears honeycombed, the depressions conforming to the underlying convolutions. These depressions are attributed by most authors to pressure of the underlying convolutions in a skull unable to expand because of suture closure. Vessel markings are exaggerated; the base of the skull also shows the result of this craniostenosis, as the middle fossa is often pushed down near the level of the posterior fossa and the anterior fossa is shortened and distorted. The frontal sinuses are obliterated in extreme cases. Obliteration of ethmoids has also been noted. The shallow orbits can be plainly seen. There may be a definite protrusion at the anterior fontanel and at times an actual break in the skull and the protrusion of brain,—a spontaneous decompression.

Suture obliteration is usually seen. The sella may be clearly outlined; or it may be widened and displaced backward.

In the illustrative case of congenital idiocy two of the cardinal symptoms of tower skull were lacking, namely, exophthalmos and roentgenographic evidence of suture closure.

Delbet, Pierre and Mornard, Pierre. Chronic arthritis of the hip with subluxation and progressive ankylosis in the adult. *Rev. de chir., Par.*, 1925, xliv, 13–38.

Six case reports are given describing chronic arthritis of rather peculiar symptoms, obscure in nature but with characteristic symptoms. Cases in which neither traumatism nor pathologic conditions were the inciting cause; one in which the patient had remained in a reclining position for two years; others having no apparent cause for the condition. In these cases roentgenograms were made of the hip joint which showed very clearly the abnormal conditions resulting. In one case there was deformation of the head of the femur in the supero-external region and the neck of the femur. The cotyloid cavity was enlarged; the curve was large, open and there were many points of osseous outgrowths. The femur was dislocated postero-superiorly. In the second case a somewhat similar picture is shown with numerous bony outgrowths; the neck of the femur was in a vertical position. General examination was completely negative, including Wassermann reaction. The third case showed a deformation of the head of the femur with bony outgrowth below the neck; the cotyloid cavity was filled in the inferior part by osteophytic masses; there was posterior-superior subluxation. In the fourth case, the head of the femur was deformed on the infero-internal part; the large thickened neck was short; the cotyloid cavity was eroded on its posterior-superior part, and there were bony outgrowths below the head; there was also subluxation of the femur. The roentgenograms of the fifth and sixth cases showed somewhat similar pictures. Roentgenograms and drawings are given to illustrate these peculiar cases.

Duval, Pierre, Béclère, Heri and Porcher. Duodenal stenosis complicating gastric affections. *Bull. et mém. Soc. de radiol. méd. de France, Par.*, 1925, xiii, 26–27.

Three case reports are given in which roentgenograms were used to study certain characteristic gastric affections and in each of which stenosis of the duodenum was observed. The first patient, a woman aged forty-one, presented a typical case of linitis with incontinance of the pylorus with dilatation of the whole duodenal cycle. A series of roentgenograms showed the stages of the dilatation and stenosis. The second case showed periduodenitis stenosis. There was a large dilatation and antiperistaltic movements. The third case had been operated on for ulcer of the duodenum in December, 1922. In June, 1924, marked stagnation was noted with numerous antiperistaltic movements, and stenosis. In all these cases the roentgenograms were made, and confirmed the diagnosis, and also made clear the extent of the affections.

Gaube, Konrad. A case of multiple myeloma resembling transverse myelitis. *Med. Klinik*, Feb. 13, 1925, xxi, 244–245.

A description is given of a case occurring in a man aged sixty-five, complaining of dizziness and having general symptoms suggesting caries of the vertebrae causing a compression myelitis. This diagnosis seemed to be confirmed by the roentgen examination of the spinal column which revealed the eighth thoracic vertebra very much narrowed and wedge-shaped and compressed almost to a plate from front to back. To the right of this vertebra a semicircular shadow was seen that was interpreted as a cold abscess. In the urinary sediment of the patient were many leucocytes due to a cystitis but there were no other pathological constituents. The sputum was negative for acid-fast rods, but the Pirquet skin test was positive.

The patient gradually weakened, developed a bronchitis and died, the clinical diagnosis being transverse myelitis following caries of the eighth thoracic vertebra with the formation of a cold abscess; paraplegia of the lower extremities, bronchitis, cystitis, and decubitus. At autopsy the findings in general were confirmed, except for the diagnosis of the primary illness. Numerous myelomas were found in the bodies of the vertebrae, ribs, and of the right femur. These myelomas examined histologically were shown to be of the plasma cell type. The unusual course of the disease made it impossible to establish a correct clinical diagnosis. This case is further striking in that the characteristic Bence-Jones protein was absent from the urine, and the roentgen examination failed to reveal the true condition.

GIORDANO, D. Bilateral urinary calculosis. *Arch. ital. di urol., Bologna*, August, 1924, i, 101–111.

The patient was a stout, anemic woman of thirty-nine who for some years had suffered from renal colic. Roentgen examination showed a large calculus 8 to 10 cm. long and 1 cm. broad in the pelvis of the right kidney and upper part of the ureter which was enormously dilated, and a smaller one about 3 cm. long and 1 cm. broad in the left ureter. Urine was still being passed from both kidneys between the stones and the walls of the ureters. The right kidney was functioning better than the left as only 25 c.c. of urine were obtained on the left and 50 c.c. on the right; that from the left kidney contained more pus and albumin than that from the right. The right kidney seemed to have reached a certain stage of equilibrium where it could function, although imperfectly, while the left one was undergoing an acute attack. In view of the woman's condition and the poor function of the kidneys operation seemed dangerous yet it seemed imperative. Though the stone in the right kidney was much larger the author decided to operate on the left side first, as that kidney was in the worse condition. Pyelotomy was performed and the stone removed, the wound in the pelvis being left unsutured for the purpose of draining the kidney. The patient's general condition and kidney function improved so much after this operation that it was possible to remove the stone on the right side two weeks later and she was discharged in good general condition.

HOTZ. Roentgenological studies of the infant's stomach. *Schweizer. med. Wchnschr.*, Dec. 3, 1925, lv, 1105–1111.

The greater the volume of the meal and the lower its consistency, the greater is the size of the infant's stomach as seen in the roentgenogram. As the consistency of the food increases the peristaltic reaction of the stomach becomes greater, accordingly the most pronounced peristalsis is obtained with the thickest form of infant food, namely gruel. Fluid nourishment not only inhibits peristalsis but also favors the swallowing of air, which, through the production of a large air space, leads to increase in the size of the stomach. Further, more air is swallowed in general when the nourishment is given out of a bottle than when it is fed with a spoon.

Variations in size of the stomach can be quite considerable in the same child under normal and pathological conditions. The same applies to a certain degree to the shape of the stomach. The variations in shape observed in numerous examinations may be divided into two general classes: (1) the large, more or less horizontal oval stomach, and (2) the small, round stomach.

It is possible to influence the size of the stomach to a considerable degree by the type of nourishment offered. This is of great practical importance since it is related to important functional disturbances such as vomiting. In most infants suffering from these disturbances, we find a large stomach with a large air bubble. These infants comprise the nervous vomiters, the ruminants and the children with pyloric stenosis. If it is possible, as is usually the case, by thickening the nutriment, decreasing its bulk and by a certain technique of feeding, to decrease the size of the stomach, we find that the functional disturbance usually also disappears.

The fact that the symptoms of pyloric stenosis usually occur in breast fed children is undoubtedly partly due to the fact that these children very often swallow a good deal of air. Very good therapeutic results are reported following the use of thickened nutriment, especially in cases of pyloric stenosis. A series of roentgenograms is given showing the effects upon the shape and size of the stomach by the factors mentioned. A description is given of a symptom of pyloric stenosis which is frequently demonstrable in the roentgenogram, namely, a clearly visible, high grade thickening of the gastric wall.

HURST, ARTHUR F. Carcinoma of the stomach: Auxiliary methods of diagnosis—radiological and chemical. *Brit. M. J., Lond.*, Nov. 14, 1925, ii, 879–882.

The general practitioner must recognize that if the symptoms are not the result of some obvious cause and do not rapidly respond to simple

treatment, the patient should undergo a complete investigation with the object of settling the diagnosis. In a very large majority of cases, it is possible to make a definite decision within ten days of taking a patient into a hospital or clinic whether the likelihood of cancer of the stomach is sufficiently great to warrant operation. In the investigation of such a case there are three principal aids to diagnosis: test meals, roentgenography and examination of the stools. The test meal helps in many cases and the roentgen rays and examination of the stools in all, but reliable results can only be obtained when the tests are carried out by observers who are familiar with the weaknesses of the methods and how they can be avoided.

A fractional test meal properly carried out and properly interpreted gives very valuable information in a considerable proportion of cases of cancer of the stomach. The questions to consider are: the character of the "resting juice;" the acidity during the meal, and the presence of blood.

In one clinic employing an expert in the roentgenology of the alimentary tract definite evidence of the presence of a growth was to be found in every case. In another series made at another clinic definite evidence was obtained in only 50 per cent of the cases because pressure of work and examinations by various observers of little experience interfered with a high average accuracy. The roentgenological evidence of cancer of the stomach is not yet quite so trustworthy as in the case of gastric or duodenal ulcer. If other evidence is very strong, the author would be prepared to advise operation in a case of suspected stomach carcinoma even if the roentgenogram showed nothing abnormal.

It is remarkable how normal the roentgenographic appearance of the stomach may be even with growths of considerable size. For this reason the screen examination is of still greater importance, especially with early growths involving the pyloric half of the stomach. Careful observation in most of these cases reveals some abnormality in the peristaltic waves. Instead of becoming slowly and steadily deeper as they approach the pylorus, they may disappear entirely, or they disappear and reappear an inch or more farther along the curvature. This has often been observed in the absence of any permanent filling defect. Unfortunately, it is in the cardiac half of the stomach, in which peristalsis does not normally occur, that filling defects are most likely to be missed. The difficulty of deciding whether pyloric obstruction is due to cancer or some other cause can be overcome by completely emptying the stomach with a Senoran's evacuator before the opaque meal is given. In pyloric obstruction, the stomach always contains fluid and often some food residue when the patient is fasting in the morning. Consequently when the opaque meal is swallowed it drops to the bottom of a distended stomach. The transparent gastric contents are generally not observed; and a diagnosis of dilatation due to obstruction is made, but as the opaque meal lies in the dependent part of the stomach the immediate neighborhood of the obstruction is not clearly seen. After being evacuated, it is found that the stomach though previously distended, is not permanently dilated since it nearly always contracts to a normal, or almost normal size. Consequently an opaque meal taken now fills the stomach in a normal manner and the outline of the pyloric end of the stomach and the progress of the peristaltic waves from their commencement to their end can be satisfactorily investigated.

JOHNSON, A. SYME. *X*-rays as an aid in the diagnosis of the pathological gall-bladder. *Med. J. Australia*, Nov. 7, 1925, ii, 545–548.

The direct signs of pathological gall-bladder are only two in number,—visible gallstones and a visible pathological gall-bladder. Unfortunately, even with most perfect technique and apparatus it is often very difficult or impossible to secure films on which gallstones can be identified even when present. The outline of the bladder may be secured in a fair proportion of cases by careful attention to details in making the roentgenogram.

Assistance in diagnosing gall-bladder disease may be obtained indirectly from signs affecting the stomach, the duodenum and the colon. The great value of the indirect signs is their number, the mutual support they give to one another and the ease with which they are demonstrated and recorded. If only one or two of the important pieces of evidence are present, the diagnosis is suggested; given a sufficient number present in any one patient, the conclusion is almost absolute. These signs do not and cannot distinguish between the presence or absence of stones, but when all is said and done, this distinction is not usually of the first surgical importance. In all probability, a gallstone is only an incident in a cholecystitis.

These roentgen-ray signs have no present known relation to the clinical symptoms or to their intensity. The author has averaged the results of 4 prominent workers and finds, out of a total number of 209 cases reported, the roentgenological findings were confirmed at oper-

ation in 89.3 per cent; the remainder were in error.

Mention is made of the great promise held forth by the new method of cholecystography using tetrabromphenolphthalein.

JULLIEN, L. The diagnosis of pulmonary tuberculosis and the adaptibility to military service. *Presse méd., Par.*, 1925, No. 78, 1301–1304.

The recognition of clinical symptoms is of first importance, but the roentgenoscope and the roentgenogram are of much importance in studying the lesions in the lungs. By using the roentgenoscope and the roentgenogram, it is possible to determine the old lesions and, in the young soldiers, to show the differences between tuberculous lesions and false lesions due to certain other abnormal respiratory conditions. Both the roentgenoscope and the roentgenogram are indispensable in the military service in the examination of young soldiers.

KNAGGS, R. LAWFORD. On osteitis deformans (Paget's disease) and its relation to osteitis fibrosa and osteomalacia. *Brit. J. Surg.*, October, 1925, xiii, 206–237.

A review is given of the newer knowledge of osteitis deformans and its relation to some other bone affections. The important and characteristic clinical feature of osteitis deformans is pain in the bones long before any alteration can be detected in them. It is rare for the disease to start before the age of forty, although earlier cases have been recorded.

Enlargement and softening characterize the bones which are attacked by the disease. The long bones are not only greatly thickened, their circumference and sectional area being much enlarged, but they are also elongated and unduly curved. The alteration in the normal curves is due to the superincumbent weight acting upon bone softened and rarefied by the disease. Notwithstanding the elongation of the long bones a decrease in height is a constant result in persons suffering from osteitis deformans.

In the skull three typical stages of alteration can be recognized: (1) the vascular stage; (2) advancing sclerosis, and (3) complete diffuse sclerosis. The curvature and thickening of the spine are noted and the changes in the long bones are described macroscopically and microscopically. The complications of the disease are listed under the headings, fractures, necrosis, ulceration or discoloration, atheromatous arteries, osteoarthritic changes, and malignant disease.

Of the various theories as to the pathogenesis of Paget's disease the toxic theory is more in harmony with known facts than any other. There is evidence that certain diseases of the bones owe their origin to the action of toxins, probably those of metabolic or intestinal origin. It may be assumed that there is an idiosyncrasy in certain individuals predisposing to the development of such diseases. The ability of the bones to resist toxic influences is a factor of great importance. The relative intensity of that resistance can be roughly gauged by the extent and character of the reaction excited in the soft tissues of the affected bones. If the vitality is good, the resistance opposed to the toxins may ward off harmful effects until the constitutional strength is reduced by age and disease. The reaction under these circumstances is strong, and the resulting affection takes the form of osteitis deformans. On the other hand, if vitality is feeble the disease appears earlier,—in childhood, adolescence or early manhood. The reaction is fair but not so vigorous as in osteitis deformans and the disease then assumes the form of osteitis fibrosa. Lastly, when, owing to the severe depression of the patient's vitality, usually by untoward circumstances, the power to react is absent, then osteomalacia develops.

KRAUS, ERIK JOHANNES, and WALTER, ARNO. Albers-Schönberg's disease. *Med. Klinik*, Jan. 4, 1925, xxi, 19–22.

A description is given of a case occurring in a girl aged three. The blood examination showed 2.7 million erythrocytes, 12,800 white cells, relative lymphocytosis, 33 per cent hemoblogin, isocytosis, poikilocytosis, polychromatophilia and normoblasts. A few weeks before death the white cells numbered 5,300 and there were 30 per cent myelocytes. Autopsy disclosed a high grade general anemia and general atrophy and hyperemia of the lymph glands; extensive sclerosis of the bony system with complete ossification of the marrow spaces; extensive subperiosteal hemorrhages, especially at the ribs; extensive fresh hemorrhages in the dura mater, thickening of the latter and adhesion to the cranium; thickening of the leptomeninges; atrophy of the optic nerve, with bilaterally narrowed optic canals; edema of the brain and healed fracture of the right femur.

The autopsy findings are described in detail, together with the histological features of the various organs and bones. These features are typical of Albers-Schönberg's disease, and give an indication of the possible etiology and genesis of the condition. It is the author's hypothesis that Albers-Schönberg's disease is caused by a congenital disturbance of the primary bone marrow in the sense of a constitutional disease,

and it is suggested that this hypothesis is more justified than others that have been put forth.

LANGE, F. Two cases of situs inversus totalis and their behavior in the electrocardiogram. *Med. Klinik*, Feb. 27, 1925, xxi, 321–323.

The roentgenogram reveals at a glance the presence of the above anomaly; and the roentgenogram is no less valuable in the diagnosis of congenital heart defect associated so frequently with situs inversus.

In the two cases described which were determined roentgenographically to be cases of total situs inversus, the electrocardiogram showed a uniform inversion of the A, J, and F waves.

LERNER, MACY L. Oxycephaly, with ocular complications. *Am. J. Ophth., Chicago*, July, 1925, viii, 542–546.

In the case reported in a man aged forty-two, vision was lost after an attack of pertussis at the age of five years, accompanied by convulsions. There was atrophy of both optic nerves and characteristic deformity of the skull. There was no history of rickets. The roentgenological findings were: middle and posterior fossae nearly on the same level; sella turcica is deepened and widened, sinuses are almost obliterated. The bones of the cranium are thinned out and digital depressions are present, due to the pressure of the convolutions of the brain. Bulging of the posterior and anterior fontanelles is also noted. The patient had exophthalmos.

LEWALD, LEON T. Gastro-intestinal conditions roentgenologically considered. *Long Island M. J., Brooklyn*, February, 1925, xix, 42.

A brief review is presented of some unusual pathological conditions of the gastrointestinal tract which any physician might encounter in his daily practice. It is pointed out that roentgen rays make possible the recognition of abnormalities which were formerly discovered only by exploratory operations or at autopsies. The early recognition of such conditions often makes for their successful treatment. The conditions touched upon are stricture of the esophagus, diverticulosis, cardiospasm, diaphragmatic hernia, gastric ptosis, gall-bladder visualization, intussusception and transposition of the viscera.

LEWIN, PHILIP. Early diagnosis and treatment of tuberculosis of joints. *Illinois M. J.*, January, 1925, xlvii, 41–46.

A condensed outline is given of the symptoms, complications, direct diagnosis, differential diagnosis and treatment of early tuberculosis of joints.

Among the various clinical and laboratory examinations the roentgenographic characteristics mentioned are (1) haziness or clouding of joint space; (2) narrowing of joint space; (3) bone atrophy; (4) bone destruction; (5) bone production (*a*) secondary infection, (*b*) calcification of exudate, and (*c*) periosteal tuberculosis. Roentgenographic aspects are also considered in differential diagnosis.

LILLIE, HAROLD I. Osteomyelitis of the cranial bones secondary to the paranasal sinus operations. *Ann. Otol., Rhinol. & Laryngol., St. Louis*, June, 1925, xxxiv, 353–360.

Osteomyelitis secondary to disease of the paranasal sinuses is an extremely grave complication. The disease may continue over a rather long period. One must resort to radical measures even though deformity may result. When dealing with osteomyelitis secondary to paranasal sinus disease, a conservative attitude must be discarded. The roentgenogram may show a picture quite typical of syphilis, but in association with sinus disease osteomyelitis must be suspected.

A report is given of 2 cases observed in the Mayo Clinic. The roentgenographic findings were interesting and at first seemed to offer an explanation, because they suggested a syphilitic process. There was extensive osteomyelitis of the frontal bone, nasal, malar and left parietal, and a densely cloudy left antrum, probably syphilitic in nature. Both patients died. In the one case which came to autopsy the clinical findings were confirmed.

LYNHAM, J. E. A. The use of *x*-rays in the diagnosis of pulmonary tuberculosis. *Tubercle, Lond.*, July, 1925, vi, 473–481.

In reading a film it is well to follow some systematic procedure. With a film of moderate density and fair detail one should train one's self to cover the following points: (1) Note the inner ends of the clavicles; if they are symmetrical with regard to the spine it may be assumed that the patient was properly placed with regard to the tube and the film. (2) The diaphragm should be sharp; if not, the patient breathed during the exposure. (3) The margins of the ribs should be sharp. The lower ribs show movement more definitely than do the upper. A loss of parallelism in the ribs is seldom seen without long-standing lung disease or curvature in the spine. (4) The number of ribs showing between the clavicle and the diaphragm should be about eight, assuming the film to have been placed 30 inches from the tube. In round-shouldered persons the number

may be less. (5) Note the form and position of the heart shadows. (6) Consider the root shadows. These are, in the main, of vascular origin, but enlarged or calcified glands may be present, thickening of the peribronchial connective sheath, caseated areas, patches of bronchopneumonia, residual pneumonia, fibrotic areas, or neoplasms. (7) Note whether the trachea is mesial or deflected and whether the outline and position of the aortic arch shadow are within normal limits. (8) Note the bronchial arborisation shadows. (9) Look for thickening of the pleura showing as density over the lung fields or as a dark line at the outer margin of the lung picture. (10) Consider the lungs themselves. Variations in all these structures can be shown in a series of films.

The author is of the belief that some roentgenologists are inclined to include the involvement of glands as hilic tuberculosis, whereas there would appear to be a very great distinction between gland involvement and lung involvement. An imperfect film will show opacity at the roots which may be erroneously called hilum tuberculosis. A very slight degree of movement in a case where both roots and lung are involved may cause obliteration of minute lung opacities while the hilum shadows remain. In cases of partly healed lung tuberculosis the residual fibrosis with caseated areas is more evident about the roots.

A word of warning must be given concerning the shadows seen in cases of chronic heart disease. The infarcts of mitral stenosis may look extraordinarily like areas of caseation, and the opacities resulting from chronic venous congestion with minute hemorrhages may give a picture extremely like that of tuberculosis. There are cases where even when the cardiac condition is known to exist, it may be impossible to decide whether tuberculosis is present.

MAXWELL, J. PRESTON, and MILES, LEE M. Osteomalacia in China. *J. Obst. & Gynaec. Brit. Emp., Lond.*, 1925, xxxii, 433–472.

China is at present one of the world centers for the study of osteomalacia. The disease is present in a large section of Manchuria, and the endemic area extends far into the central portion of China. Three or four small areas are found in the southern provinces.

Osteomalacia is due to more symptoms than its name would imply. Contrary to the usual belief, it often begins at about the age of puberty, and besides bone deformity within the pelvis and the chest, there are marked symptoms referable to the nervous system, the muscles and the teeth. The effects of this disease become more pronounced in pregnancy and during parturition. There are definite changes in the skeletal system of the fetus born from mothers who have osteomalacia. These changes are especially marked about the growing ends of the long bones and consist in a shortage of ostein, a poor quality of chondrin and an absence of a proper zone of calcification. When the bones are analyzed, the elements are contained in their proper proportions, but there is a general deficiency of the salts which should be present in normal bone. There is no evidence of prenatal rickets. The centers of ossification are apparently normal in position and time of appearance.

Osteomalacia is a diet deficiency disease and is to be placed in the same category as rickets. The deficiency is principally in the fat soluble vitamin, or calcium activator content of the diet, although there may be, and probably is, an actual or at least a proportional calcium deficiency at the same time. The result of this deficiency diet is that a disturbance of the normal calcium metabolism is set up, and it is possible that in addition to the diet deficiency there is a toxic process set up. Intercurrent septic affections will aid in the progress of the disease, but probably only by lowering the general vitality, and there is no evidence of such infection in the majority of cases. The evidence suggesting disease processes in the ovaries and parathyroids is insufficient to place the blame for the disease on either of these organs. Lack of sunlight and movement are contributing factors in the production of osteomalacia. By improving the diet and supplying codliver oil it should be possible in due time to stamp out the disease. Prevention is the principal thing. Animals also suffer from this disease and can be cured by the administration of codliver oil.

The bones of full-time fetuses from mothers with osteomalacia do not show the signs of rickets but of osteoporosis. There is, however, a little evidence to suggest that these infants develop rickets more easily than the normal child. The sequelae of the disease in adults are two-fold: (1) Deformity of the pelvis, the results of which on labor may be counteracted by a planned Caesarean section; (2) interference with marital relations, which may be corrected by a new operation in which portions of the pubes and ischium are resected.

MEYER, KEITH T. The roentgen-ray diagnosis of renal tumors. *Radiology*, November, 1925, v, 416–424.

The insidious onset of renal tumors makes it particularly difficult to arrive at an early

successful clinical diagnosis. Usually it is only after the discovery of a palpable tumor mass or a sudden severe gross hematuria that the physician is awakened to the fact that the patient has a pathological process in the urinary tract. The roentgenologist should be associated with a competent urologist who by cystoscopy can aid materially in arriving at a successful diagnosis.

In the study of renal tumors by means of the roentgen ray, it is essential that the intestinal tract be as free from gas and fecal concretions as possible. All kidney examinations by the author are made on 14 by 17 duplitized films with double screens on a Potter-Bucky diaphragm. Two films are used: On one the crest of the ilium is placed one inch above the center of the film, thus giving a complete view of the bladder and ureters; on the other, the crest of the ilium is placed one inch below the center of the film, thus showing both kidneys and both ureters. Fairly deep compression, by means of an inflated rubber bag is always used and the tube is placed over the center of the diaphragm without tilting.

Failure to visualize the normal kidney on the roentgenogram suggests definite renal or perirenal pathology. This is more particularly true in individuals with undeveloped muscles than in those with powerful abdominal muscles, which are obstacles to compression. Distention of the colon constitutes one of the simplest and most harmless methods of examining the kidneys. The insufflation should be under roentgenoscopic control; for in each case there is a certain amount of gas which gives the best result. This will generally determine whether a given abdominal tumor belongs to the kidney or not. These roentgenograms therefore should determine definitely in 90 per cent of cases the presence of renal, ureteral and bladder stones; also the size, position and contour of the kidneys. After satisfactory roentgenograms have been obtained, the patient is then cystoscoped and a pyelogram is taken of the offending kidney. In pyelograms of kidneys in which nothing definitely wrong has been found, one is impressed with the marked variation in the types of pelves found.

The roentgenographic and pyelographic evidence of renal tumors may closely simulate in some cases those of other nephropathies; and it will be only by a careful consideration of the cystoscopic findings, together with a careful clinical and physical examination that a successful diagnosis can be reached. In considering roentgenographic evidence of renal tumor, one must consider not only the increase in the size of the kidney but also the contour and density of the kidney shadow. An increase in the size of the kidney due to a tumor will be sharply defined. An irregular contour of the shadow would be highly suggestive of a renal tumor.

The pyelographic evidence of renal tumor may be determined from the size and contour of the pelvis, from the marked variation from normal of the major calyces, or from the changes seen in both the pelvis and calyces. Tumors arising in the pelvis may occlude it entirely or show a definite filling defect in the contour. In addition there may be a marked clubbing, dilatation, or elongation of one or more of the calyces. One must consider the possibility of a filling defect in the pelvis as being due to a non-opaque stone or to an unorganized blood clot. Tumors originating from the parenchyma may show very little change up to a marked change in the size and contour of the pelvis. Particular attention should be paid to the course of the ureter to determine whether it has been displaced either inwardly or outwardly, as either condition would be highly suggestive of a renal tumor.

Six cases are briefly reported and illustrated by roentgenograms.

MOORE, SHERWOOD. Traumatic fractures of the vertebral column. *J. Missouri State M. Ass.*, November, 1925, xxii, 417–422.

Traumatic fractures of the vertebral column unaccompanied by cord or nerve symptoms are very frequently unrecognized unless accidentally discovered in the course of a roentgen examination made on account of pain and stiffness of the back or pain referred to some other part of the body. Limitation of motion or stress bearing capacity of any vertebra affects the entire column. Spinal rigidity or weakness is a major disability increasing in importance with descent in the social scale. The roentgenographic aspect of obscure fractures of the spine is not sufficiently stressed. Accurate early roentgen diagnosis of questionable cases is essential since the results are so disastrous if correct treatment is not given.

That there are limitations to the roentgen examination of the spine beyond which it may supply no information is to be conceded. This is as true with respect to fractures as with other pathological conditions. Fracture of a vertebra may involve any of its parts. Fracture of the transverse process of a thoracic vertebra is either practically never recognized or it never takes place. There is strong reason to believe that the latter is the case. The spinous processes appear to be but rarely fractured. Since it is obvious that they are frequently subjected to

direct violence the conclusion is forced that such fractures are of little importance and that their detection by the roentgenogram is impossible except in the cervical region where alone lateral roentgenography is satisfactorily applicable to the spinous processes. Fractures of the laminae, except in the neck, are equally difficult of detection. In the upper thoracic region fractures of the vertebral bodies, unless *extreme*, are also hard to demonstrate. Finally, any fracture of any portion of any vertebra may be so slight that it cannot be demonstrated roentgenographically. With a history of trauma and symptoms of vertebral injury, a negative roentgenographic examination does not warrant the omission of treatment directed toward correction of fracture of the spinal column.

Since 1911 there have been noted in the roentgen laboratory of the Washington University School of Medicine 69 fractures of the spinal column, about 3 per cent of the total number of fractures observed during the same period. Of the total number of cases 21 were acute, with a classical picture of spinal fracture. Forty-eight cases were adventitious discoveries lacking cord symptoms.

NEGRO, MARIO. Pyelography in polycystic kidney. *Arch. ital. di urol., Bologna*, August, 1924, i, 137–140.

The results obtained in pyelography of polycystic kidney have thus far been rather contradictory. Braasch found a shortening of the calyces, extending even to complete obliteration, while Papin found a considerable lengthening of the calyces. Negro describes a case of pyelography in polycystic kidney which he observed in Prof. Marion's service. The patient presented the clinical symptoms of bilateral infected polycystic kidney, which was confirmed by examination of the urine. Roentgenographic examination was negative. Cystoscopic examination showed nothing except slight redness of the trigone. Pyelography showed a considerable lengthening of the calyces of the left kidney like that reported by Papin and Ascoli in their cases; the pyelogram of the right kidney was negative because it was impossible to distend the pelvis with the opaque liquid, which flowed back into the bladder. The pyelogram also showed a deviation of the ureters toward the spinal column, more marked on the left, which is common in greatly enlarged kidneys. A second pyelogram is reproduced sent by Dr. Eisendrath of Chicago. It was obtained in a case of bilateral polycystic kidney and shows elongation of the calyces.

PIRONDINI, EUGENIO. Cystography with opaque liquids. *Arch. ital. di urol., Bologna*, November, 1924, i, 266–274.

Cystography may be extremely useful when the passage of the endoscope is impossible or inexpedient or when endoscopy is seriously interfered with by copious hemorrhage. In a former article on the subject the author pointed out that the lower margin of the bladder shadow under normal conditions never passes beyond the symphysis of the pubis, but in adenoma of the prostate it may be raised above the pubis. It is impossible to fix a minimum of height above the pubic line which makes a diagnosis of adenoma of the prostate certain. Elevations of less than 10 mm. are of doubtful value, and still more so if they affect only a limited part of the cystographic shadow. Such slight elevations are not unusual in cases of primary epithelioma of the prostate. Sometimes there are well defined elevations without adenoma for reasons that are as yet unknown. Sometimes the shadows that appear in the vesico-pubic space are referable to the sacrococcygeal spinal column.

Cystography may be of great importance in cases of bladder tumor, especially when there is only a suspicion of tumor, and hematuria renders cystoscopy impossible. In this case large clots may simulate neoplastic masses. Cystography also often aids in showing the exact localization of a tumor because it shows much more detail than cystoscopy. It also shows the true size of a tumor better than cystoscopy, which may give the impression that the tumor is much larger than it really is if it is located near the neck of the bladder.

QUIMBY, WILL A. *X*-ray diagnosis of chronic pancreatitis and its relation to some of the common skin diseases. *J. Radiology*, May, 1925, vi, 186–188.

The duodenum and its two adjacent organs, the pancreas and the gall-bladder, should be studied as a unit. Since the duodenal contents may readily enter the ampulla of Vater and thence into the pancreatic and common bile ducts, there is possibility of an infection being carried along in the same direction.

Roentgenoscopy combined with the barium meal offers the greatest aid in the diagnosis of pancreatic diseases. Chronic pancreatitis is characterized clinically by nausea, tenderness over the region of the pancreas, and cutaneous manifestations of the dry, scaly variety. Every case of a severe or prolonged cholecystitis treated surgically should have an examination made of the pancreas. Roentgenoscopic examination will elicit tenderness beginning over

the site of the gall-bladder, extending downward over the head of the pancreas and thence across the abdomen considerably beyond the median line or to the tail of the gland. Ordinarily, tenderness where the tail of the pancreas rests is not a common occurrence. In a patient having good muscle tone the tenderness extends across the abdomen at or just above the umbilicus. Internally the greater curvature of the stomach hangs down to or slightly overlies the pancreas. In case of a pendulous abdomen and stomach, the latter must be raised out of the way in the usual manner in order to permit study of the pancreas.

SABATINI, G., and MILANI, E. Roentgenologic visibility of the gall-bladder after administration of alkaline bromides. *Presse méd., Par.*, 1925, No. 69, 1160–1161.

After administration of bromides, there seems to be a particular electivity on the part of the gall-bladder whereby these salts are deposited in this sac and cause it to become clearly outlined in roentgenograms. Considerable care is necessary in preparation of the patient if good results are to be obtained. A very light diet is given some hours before, followed by a purgative, and then no food whatever, neither solid nor liquid, is given before administration of bromides. Twenty grams of sodium bromide and strontium bromide dissolved in 100 to 150 c.c. of water are given. In some cases it is necessary to give only 10 to 15 grams of bromide; in other cases more is given. Roentgenograms are made 5, 8 and 12 hours after administration of bromides. The patient is placed on his ventral side, with shoulder and right arm slightly raised, and the roentgenogram made in the usual way. By this method, success has been attended in 60 per cent of healthy subjects and in 80 per cent of patients suffering from cholecystitis.

SALMOND, R. W. A. The *x*-ray appearances of tuberculous joints. *Tubercle, Lond.*, December, 1924, vi, 123–126.

A knowledge of the pathology of the disease as it affects the ends of the bones and joints enables one to recognize more clearly and interpret more accurately the roentgen-ray appearances. The site of origin in the bones is usually near the epiphyseal cartilage. Tuberculosis never starts in the articular cartilage or in the ligaments. Primary bone disease is more common in children; in adults the disease begins with about equal frequency in bone and in the synovial membrane.

When the disease has its primary origin in the bone there first occurs a circumvascular area of necrosis in the marrow near the epiphyseal line. This is the primary bone tubercle. This spreads and granulation tissue is thrown out, to be invaded by the disease or converted into fibrous tissue surrounding and arresting the disease. If there is arrest, the focus shrinks and the central deposit may become calcified. Otherwise caries or absorption of the bony structure occurs and sooner or later becomes caseous. It is usual to find the two processes of osteoporosis and osteosclerosis going on simultaneously, osteosclerosis predominating in the chronic cases and osteoporosis in the acute ones.

When the disease is of primary synovial origin the tubercle may remain localized or infect the whole joint. The membrane becomes swollen and the ligaments and surrounding soft tissues edematous.

In the roentgen examination of tuberculous joints, plates or films should always be used as much more detail can be obtained than from screening. If there is no bony focus the roentgenographic appearance, though it may be suggestive of tuberculosis, shows nothing peculiar to this disease alone. The presence of increased translucency or rarefaction of the bony structure is nearly constant in active tuberculous disease of any duration and is due to the absorption of lime salts. All the bones of a tuberculous subject may, however, show this without any bone disease being present. It is not usually possible to distinguish with any certainty between swollen synovial membrane, and serous and purulent effusions from a roentgenogram alone. The bones and soft tissues in the neighborhood of a tuberculous joint show atrophy after some time. Another characteristic of tuberculous joints is that there is no new bone formation. The roentgenographic appearances in a case affecting the bone or joint are exactly what would be expected from the pathology.

SCHIRMER, A. Osteochondritis dissecans of the elbow. *Schweizer. med. Wchnschr.*, May 28, 1925, lv, 489–490.

A report is given of 4 cases occurring in males of eighteen, twenty, twenty-five and fifty-three years in each of whom the right elbow presented some stage of osteochondritis dissecans. History of trauma was either very insignificant or most pronounced; but the general disease picture in each fitted in closely with the classical picture.

The roentgen findings in each of the 4 cases are described. In the first case the roentgenogram shows a gnawed out bone defect at the capitulum humeri and two small, sharply outlined, rounded bone shadows lying free in

the joint space. In the second case the roentgenogram showed a distinct split in the region of the capitulum humeri. The diagnosis made was osteochondritis humeri dissecans, with two bone cartilage fragments apparently still retained in place. The roentgenograms in the other cases were similar. Operation in each case disclosed the bone fragments and confirmed the roentgenological pictures.

It would seem that trauma is not always the cause of this condition.

SMITHIES, FRANK, and OLESON, RICHARD B. The visualization of the biliary tract. A new method by intravenous injections of tetrabromphenolphthalein. *Illinois M. J.*, February, 1925, xlvii, 97–100.

The observations of the authors are a complete confirmation of those made by Graham and Cole. In cases that have come to operation or to autopsy the findings, when the body was opened, have confirmed those elicited by the test.

It has been observed that the shadows of relatively slight density that occur on the roentgenogram become accentuated and more clearly brought out when the roentgenogram is reduced in size to that of the ordinary lantern slide. It is suggested that this may be an advantageous procedure at times when the roentgenographic shadows are indistinct.

SPRIGGS, E. I., and MARXER, O. A. Intestinal diverticula. *Quart. J. Med., Oxford*, October, 1925, xix, 1–34.

A comprehensive discussion is presented of diverticula of the small and the large intestine, covering such items as incidence, roentgenographic method of diagnosis, etiology, development of diverticula, symptoms, prognosis, treatment and results. In addition, 45 figures are presented to illustrate the various aspects discussed.

Summarizing the observations, it is stated that diverticula of the duodenum are not uncommon, being observed roentgenographically in 38 out of 1000 consecutive roentgen examinations. The largest pouch measured 4.5 inches in vertical diameter, but the average size was about that of a walnut. In 2 patients who were re-examined after four and seven years respectively, the development of a pouch from a small to a considerable size was observed.

In 18 of the 38 cases, the symptoms for which the patient sought relief were thought to be due to irritation from the pouch or pouches. Some of the typical cases are cited. In 13 out of the 18 patients, complete relief was obtained by treatment directed to aiding the pouch to empty, to lubricating and disinfecting its contents and to correcting or relieving any associated symptoms. In one case of multiple duodenal and jejunal pouches gastroenterostomy was performed with success. In the same series diverticula of the jejunum were observed in 7 patients, of the ileum in 7, and of the appendix in six.

Diverticulosis of the large intestine is frequent, having been observed in 100 out of 1000 consecutive cases. The diverticula are small and multiple, may be found in any part of the colon, but are commonest in the pelvic colon. A prediverticular state can be recognized roentgenologically, characterized by fixity of the affected part of the bowel wall with small irregularities. This is the first stage of the disease at which the minute hernias begin to develop. The second stage is one of formed diverticula. The third stage is called diverticulitis. Inflammation has now spread from the pouches to the walls of the bowel and surrounding parts. This stage was well developed in only 5 of the present series.

It is suggested that diverticulosis is the result either of a degenerative or of an inflammatory process. Its association with spondylitis of the lumbar spine, which was found in 70 per cent of the diverticulous patients, as compared with 20 per cent in a control series, might favor either view; but the inflammatory appearances of the prediverticular state and the association nearly as frequent as that of spondylitis, with abscesses at the apices of the teeth, also with other septic conditions in various parts of the body, favor an infective origin. The demonstration of the prediverticular state particularly, which has now been observed in 35 patients, makes it improbable that diverticulosis is due to some passive extrusions in a weak but otherwise healthy gut.

An account is given of the roentgenologic appearances of formed diverticula and of the characteristic appearance seen in the third stage of established diverticulitis. Forty-five of the 100 patients complained of symptoms attributable to the diverticula. The condition is amenable to treatment which is directed to the lubrication, cleanliness and proper action of the bowel and the health of the body generally.

STEPHENS, RICHMOND. The diagnosis of diseases and injuries of the knee. *Long Island M. J., Brooklyn*, May, 1925, xix, 183–187.

In attempting to diagnose diseases and injuries of the knee, the roentgen ray is a most important adjunct. It is well to have in mind the appearance of the normal when viewing the femur, tibia, fibula and patella, the approxi-

mate amount of space between the femur and tibia and the position of the patella which is higher on the femur than we ordinarily realize.

Some years ago a diagnostic procedure was attempted, namely, oxygen injection, but unfortunately this has not proved to be very valuable. Under aseptic precautions oxygen was injected directly into the joint through a needle and tube from an ordinary oxygen tank, with moderate pressure, until the joint was distended to the point of discomfort. Roentgenograms taken at this time are very beautiful but give very little information.

Affections of the knee may be classified as intraarticular, extraarticular, infectious, traumatic and miscellaneous. Under intraarticular infections are listed acute and chronic arthritis, acute and chronic synovitis, intermittent "hydrops," hemarthrosis, osteochondritis dissecans, tuberculosis, syphilis, Charcot joint, gonorrhea and actinomycosis. Under traumatic arthritis are listed synovitis, hemarthrosis, foreign bodies, osteochondritis dissecans, semilunar cartilage injuries, crucial ligament injuries, fracture of tibial spine.

Under extraarticular infections are listed bursitis, osteomyelitis, periostitis, and gout. The traumatic injuries are bursitis, abrasion, contusion, laceration, sprain, strain, lateral ligament injury, Osgood-Schlatter's disease, dislocation of patella, fracture of patella, fracture of femoral condyles, fracture of tibial tuberosities, epiphyseal separation.

The miscellaneous knee conditions are congenital contracture, absence of patella, snapping knee, relaxed joint, subluxation, slipping or recurrent dislocation of patella, genu recurvatum, knock knee, bow leg, hysteria, new growths including popliteal cysts, and hemorrhagic osteomyelitis.

Brief discussions are given of acute and chronic arthritis, synovitis, hemarthrosis, osteochondritis dissecans, tuberculosis, syphilis, gonorrhea, intraarticular trauma, crucial ligament, extraarticular infections and extraarticular traumas. The author believes that Osgood-Schlatter's disease is misnamed as it is more likely an injury than a disease.

SUTHERLAND, CHARLES G. Niches of the greater curvature of the stomach; reports of two cases. *Radiology*, September, 1925, v, 248–250.

In the experience of the Mayo Clinic niches of the greater curvature are extremely rare. In palpating the stomach while it is filling with barium, small flakes of barium may be caught in folds of the rugae and for the moment give the suggestion of a niche; but further filling and continued manipulation will straighten out the rugae and reveal the normal contour.

The first case described occurred in a man aged forty-one in whom the roentgenoscopic examination revealed a large niche. This was on the greater curvature of the stomach in the pars media, with a converging of the linear markings of the rugae toward the lesion. On operation, a subacute perforating ulcer was found on the posterior wall on the vertical portion of the greater curvature. This ulcer had perforated against the sheath of the pancreas. A partial gastrectomy was performed from which the patient recovered uneventfully.

The second case was in a woman, aged twenty-eight, in whom the roentgenographic examination, using a small amount of barium revealed a niche on the greater curvature in the pars media. With the stomach filled with barium, a large filling defect became apparent, in the center of which was seen a V-shaped niche. The irregularity of the margins of the filling defect and the absence of any line of contour on the greater curvature suggested a malignant lesion. Operation revealed two carcinomatous ulcers connected by deep fissure, a marked diffused fibrosis of the walls adjacent to the growth and rather extensive lymphatic involvement. There was metastasis in the liver. The stomach growth was operable and a palliative median gastric resection was performed from which the patient recovered uneventfully.

TESCHENDORF, WERNER. The kidney shadow in the roentgenogram under pneumoperitoneum. *Med. Klinik*, Feb. 6, 1925, xxi, 207–209.

In most cases, according to the author's experience, the pneumoperitoneum complements the clinical diagnosis rather than extends it.

An examination of the kidney shadow after the production of a pneumoperitoneum discloses the shadow of the right kidney to be covered largely by the liver shadow. The shadow of the right kidney can become more pronounced under two conditions; first, enlargement of the kidney, and second, reduction in size of the liver shadow.

A case is described in which there was a definitely palpable tumor recognized as a hypernephroma and confirmed at autopsy, yet pneumoperitoneum failed to disclose the condition. The shadows of the spleen and of the left lobe of the liver partially covered the tumor. Another case is described in which a tumor was diagnosed in a normal kidney. Experience teaches that a good deal of caution is necessary in judging the size of the kidney

shadow. More than one roentgenogram is necessary with controls, taken from different angles.

VAN DER HOEVE, J., and STEENHUIS, D. J. Roentgenograms of the tear ducts after filling with lipiodol. *Klin. Monatsbl. f. Augenb.*, May–June, 1925, lxxiv, 671–681.

The roentgen examination of the tear ducts can be made to yield important conclusions as to the condition of the tear drainage apparatus. Good roentgenograms of these structures can be easily obtained through the use of lipiodol as an injection material.

The occipito-frontal and bitemporal projections give definite pictures of the lachrymal sac together with the tear ducts. Some typical pictures in cases of stenosis and abscess are given.

Lipiodol is easily introduced with the aid of an ordinary lachrymal syringe. The sac is first squeezed empty, and if necessary the duct is irrigated. The eyelids and cheek are wiped off with benzol to remove adhering oil. After making the roentgenogram the sac may be emptied by pressure or the oil may be left in place, since it is harmless. It does not in any way irritate the eye as was demonstrated by tests of the author upon himself.

Lipiodol injection as above recommended is a simple, easy and harmless method for the roentgenological study of the lachrymal apparatus and its surroundings.

VERAGUTH, OTTO. Subdural tumor of the lumbosacral cord. Lipiodol picture. Operation. Cure. *Schweizer. med. Wchnschr.*, Nov. 5, 1925, lv, 1022–1027.

The details of a case in a man aged thirty-seven are described and illustrated. The patient presented symptoms of compression of the lower portion of the spinal cord. In order to locate the involved area lipiodol injection was made intralumbarly. The patient was placed head down, and the spinal column was tapped so as to bring the lipiodol into contact with the lower pole of the tumor. Most of the lipiodol came to rest between the first and second sacral vertebrae. A drop the size of a hempseed was found frontally near the fourth lumbar vertebra, and a very small drop near the third lumbar vertebra. Later a suboccipital puncture was made and lipiodol was injected into the dural space. The patient was in an upright position and the spinal column was tapped for ten minutes to shake the lipiodol into place. A roentgenogram then taken showed an accumulation of the oil at the level of the twelfth dorsal vertebra. The clinical diagnosis was compression of the spinal cord by a tumor, the upper pole of which was at least at the level of the lower edge of the twelfth dorsal vertebra, affecting the spinal cord down at least to the segment of the first sacral, and the effects of compression extending probably, especially on the left, as far as the fourth to fifth lumbar. The lower pole of this tumor extends at least to the lower limit of the second lumbar but not below the third lumbar vertebra. From the roentgen picture it was concluded that the tumor originated not from the bone but was subdural rather than epidural.

The lipiodol picture excluded possibility of inflammation of the cauda equina, multiple sclerosis or slowly developing tuberculosis.

VON EICKEN, CARL. Air bubbles in the interior of the skull. *Acta oto-laryngol.*, 1925, viii, 128–133.

A report is given of a case observed in a woman aged thirty-two. A stereoroentgenogram showed a peculiar rarefaction in the region of the lateral ventricles and a diffuse rarefaction below the bony skull cap. The light spot in the lateral ventricle had a horizontal lower border while the upper border was curved. There was no doubt that these areas represented accumulations of air in the skull.

Cerebral fluid flowed out of the right side of the nose when the patient bent the head forward. Roentgenograms taken in different positions showed the air bubbles to shift in accordance with a change in position.

The air probably entered the brain cavity through an injury in the ethmoidal bone or the upper or posterior ethmoidal wall as a result of operation for sinusitis. This does not explain, however, how the air reached the lateral ventricles. It may be that the repeated vigorous blowing of the nose by the patient may have had something to do with forcing the air through the foramen of Magendie. These air bubbles gradually diminished in size as the patient was forced to remain in bed and rest. A recent roentgenogram shows only a very small trace of air in the skull. The air apparently was in some manner resorbed by the fluids and tissues. This sequel of operative rhinology is considered unique. It is of course well known that injuries to the mastoid permit entrance of air into the interior of the cranium.

WEISS, KONRAD. The value of long focus roentgenography in comparative investigations of the heart size. *Med. Klinik*, March 13, 1925, xxi, 402–403.

It is generally recognized by competent judges that the orthodiagraphic method of

determining heart size is open to subjective interpretations by the observer, whereas the heart contour determined by long focus roentgenography is a purely objective matter. A long focus roentgenogram taken with correct technique gives a good outline of the heart shadow and carries with it, as a proof of its utility as a standard picture, the fine markings together with the thoracic skeleton. Herein lies the particular advantage of the method.

This conclusion is based upon an examination of the archives of the Heart Station in Vienna where over one hundred thousand normal and diseased hearts have been examined.

The orthodiagraphic method serves its purposes well. It can be carried out rapidly and conveniently and at minimal initial cost. In cases where only a single examination is necessary it is quite satisfactory; but for comparative studies of the same heart under various influences or conditions, better results are to be obtained by the correct comparative long focus roentgenograms.

WILKIE, D. P. D., AND ILLINGWORTH, C. F. W. Cholecystography. *Brit. M. J., Lond.*, Dec. 5, 1925, ii, 1046–1048.

When a gall-bladder shadow is visible, if it be of normal density and contour, gross disease may be excluded, but mild cholecystitis may be present. Gallstones casting no shadow in the ordinary roentgenogram may be shown up as negative shadows. Care must be exercised not to mistake gas in the overlying colon for a gallstone. With correct technique, the absence of a gall-bladder shadow indicates one of three conditions: (1) obstruction of the cystic duct by a stone within it or in Hartmann's pouch, or by fibrosis, catarrh, or neoplasm; (2) a gall-bladder so filled by stones that dye-laden bile cannot enter; (3) a gall-bladder so diseased or shrunken as to be functionless.

In cases where the preliminary roentgenogram has shown doubtful shadows suggestive of gallstones, the accurate localization of the gall-bladder gives confirmatory evidence, the method being thus comparable to pyelography in cases of renal calculus. When a palpable lump is present in the right hypochondriac region, it is possible by cholecystography to determine whether it is a new growth in the liver or a distended gall-bladder.

In a few cases where the oral method of administration of the dye was tried by the author, the results were so inferior to those obtained by the intravenous method and the latter was so much more accurate and certain, that the intravenous method is now used exclusively.

These conclusions are based upon 53 cases in all of which a cholecystogram was taken prior to an operation on the upper abdomen. The cases included not only those in which biliary lesion was suspected but many in which the dyspeptic symptoms pointed clearly to duodenal or gastric ulcer. There was thus obtained a considerable number of controls essential in assessing the true value of the method. The dye used for intravenous injection was sodium tetraiodophenolphthalein.

WINNER, P. S. A study of 22 cases of lung abscess. *Illinois M. J.*, April, 1925, xlvii, 267–274.

Lung abscess is a rather frequent disease and must be differentiated from pulmonary tuberculosis, the roentgen ray being a valuable aid in making the diagnosis. Pneumothorax is of great aid in all cases of lung abscess if initiated early. The chronic abscess does not respond well to pneumothorax and here surgery should be tried. Simple resection with drainage is only a make-shift and does not offer permanent cure.

The cases under discussion were observed in the past four years. None of these cases has come to post mortem. The etiology of the abscesses in the 22 cases of the present series is as follows: 32 per cent followed tonsillectomy; 23 per cent followed pulmonary infection; 9 per cent followed appendectomy; 4 per cent followed measles and 32 per cent, cause unknown. The abscesses were located mostly in the upper or lower right lobe.

With the advent of the roentgen ray, lung abscess is more often recognized and treatment started sooner. Five cases are briefly cited.

ROENTGEN AND RADIUM THERAPY

BATTAGLIA, FILIPPO. Two cases of lymphosarcoma. *Arch. ital. di chir., Bologna*, 1925, xiv, 113–130.

In a man aged sixty a swelling developed in the right suprahyoid region which increased rapidly in size and remained hard. Under roentgen treatment the swelling disappeared and his general condition improved to such an extent that he seemed completely cured, but suddenly about six weeks later a similar swelling appeared on the side of the neck, invaded the neighboring muscles and caused pareses of the nerves and pain in the regions innervated by these nerves. No other organs were affected. The blood showed decrease of erythrocytes and slight leucocytosis with lymphocytosis. In another patient of twenty-nine swelling of the lymph glands of the neck

developed and progressed very slowly for two years and then for two months increased very rapidly and invaded the mouth, pharynx and respiratory tract. The lymph glands of the rest of the body were not affected. Histological examination showed lymphosarcoma. The patient died of suffocation.

There is a group of morbid processes of lymphoid tissue with clinical and anatomopathological characteristics that are not very well differentiated so that it is hard to tell whether to classify them as lymphosarcoma or pseudoleucemia. A differential characteristic between lymphosarcoma and small round-celled sarcoma is furnished by pictures of karyokinesis which are found in the smaller round cells of the latter while they are lacking in the similar cells of lymphosarcoma. Roentgen treatment brings about decrease in size of lymphosarcoma and such an improvement in the general condition that it looks like real cure, but always after a longer or shorter time the tumor resumes its growth.

Beck, Joseph C., and Pollock, Harry L. The present status of electrotherapeutic measures used in the practice of otolaryngology. *Ann. Otol., Rhinol. & Laryngol., St. Louis*, June, 1925, xxxiv, 403–414.

A brief discussion is presented of high frequency current, leucodescent heat and diathermia, the electric pulsator, vibrators, electrolysis, infra-red rays and roentgen rays in their relation to the practice of otolaryngology.

Bensaude, R., Solomon, I, and Oury, P. The roentgenotherapeutic treatment of non-neoplastic gastric affections. *Presse méd., Par.*, 1925, No. 50, 841–843.

The present investigation is concerned with the effect of the roentgen ray on such conditions as abdominal pain and the gastric secretions. The apparatus of Roycourt-Ropiquet was used; this gives a tension equivalent to 25 cm. (spark between points), an intensity of 3 ma., focal distance of 20 cm. The rays were filtered through 5 mm. of aluminum; the dose applied at each treatment was 500 R, as measured ionometrically. One or two treatments were given each week, each patient receiving a total of 14 to 16 irradiations. These were made in the region of the stomach after previous roentgenoscopy. Twenty-one patients suffered from painful stomach troubles (9 cases of ulcer, 12 cases of functional disturbances).

The first effect of the action of the roentgen ray on the secretion of gastric juice was a rapid drop in the acidity. This diminution of acidity rarely followed the irradiation immediately; usually it resulted about one hour afterwards. This lowered acidity was of short duration, and it returned to normal the following day. In two cases this fall in acidity was not apparent. In no case was the content of pepsin affected. In some cases the free HCl was reduced one-half, while in some others it completely disappeared for a short time. The decrease in total acidity and free HCl did not run parallel; the diminution in HCl was greater than the decrease in total acidity, and usually lasted longer. This effect is only passing, unless the treatment is continued over a period of many weeks, when it seems to constitute a more or less decided reduction in acidity.

The effect of the irradiations on gastric pains varied considerably; in 44 per cent of the subjects, there was no alleviation of the pain; in 21 per cent the pain was partially alleviated, while in 35 per cent the pain was considerably relieved, which was characterized by betterment of the general state of the patients. There was a beneficial effect in certain cass of gastrorrhagia also. During all these observations no harmful effect on the patient was noted. As a matter of fact, the dosage employed was not sufficient to bring about any histological changes in the region irradiated.

Borak, J. Roentgen therapy of dermatitis due to freezing. *Med. Klinik*, Feb. 1, 1925, xxi, 161–162.

Of the twenty more or less accepted remedies for the treatment of superficial freezing, roentgen rays are considered a preferred therapy because of the ease with which they are applied and of the speedy results obtained in suitable cases. The dermatitis is probably caused by a defect in superficial circulation which is aggravated by the cold. Associated with the dermatitis is a feeling of burning and itching, and varying sensitiveness to pressure, pain and cold.

These various symptoms may be relieved completely, without the aid of other remedies, by a single roentgen irradiation. In some cases a second treatment may be necessary. It is rare that a case will require repeated treatments. The degree of improvement and the duration will depend upon the condition of the general circulation.

The effect appears to be produced by the roentgen rays decreasing the abnormal sensitiveness of the vasomotor system, rather than by a possible increase in tone of the paretic blood vessels.

The roentgen rays are administered on one side, usually the dorsal, and only rarely over

both sides. The lateral surfaces of the fingers appear to obtain sufficient radiation by this method. The doses are small (3H), and lightly filtered (1 mm. Al). If necessary, the treatment is repeated in eight to fourteen days. A third irradiation is rarely necessary.

The roentgen treatment of dermatitis of freezing leaves unaffected the cosmetically disturbing acrocyanosis and diffuse swelling, if present. The treatment, however, is extremely useful in the quick relief given, the elimination of erosions, of chilblains, of rhagades and of itching and pain.

BOTT, OSKAR. The treatment of pelvic inflammations with small doses of roentgen rays. *Monatschr. f. Geburtsh. u. Gynaek., Berl.*, November, 1925, lxxi, 184–194.

The author reports on the results obtained in the treatment of 50 cases of gonorrheal adnexitis, chronic and acute, and of adnexitis and parametritis, non-gonorrheal, chronic and acute. The roentgen treatment comprised the following factors: 176 kv., 2 ma., 40 cm. skin focal distance, 20 by 24 cm. field, and 0.8 mm. Cu plus 1 mm. Al, 15 per cent of the author's skin unit dose administered over the abdomen.

The observations of Heidenhain and of Fried were only partly confirmed. Following irradiation, there was no improvement in the difficulty of treatment, especially of gonorrheal adnexitis. Case histories show that in most of the patients the period of hospitalization was in no wise diminished by the radiation treatment; on the contrary, patients required many weeks of treatment following irradiation before they could be released as improved or cured. This was true not only in acute and subacute inflammations, but especially so in the chronic cases. In not a single case was it possible to render a patient with chronic adnexitis and parametritis free of symptoms with small roentgen doses, at least with respect to duration; on the contrary, after longer or shorter fruitless conservative treatment, it became necessary to perform a temporary castration or in certain cases, total castration.

On the other hand, there was some success in the treatment of non-gonorrheal parametritis and adnexitis. The cases of adnexitis, especially the gonorrheal forms, which comprise a large portion of the gynecological material in the large city, were extremely obstinate in response to small doses of roentgen rays.

BROWN, MAURICE. The roentgen-ray treatment of various dermatoses. *Arch. Dermat. & Syph.*, June, 1925, xi, 764–767.

A large number of dermatoses that in former years stubbornly resisted all methods of treatment now lend themselves readily to properly applied doses of roentgen rays. A report is given of the experience in the Dermatological Department of Jefferson Hospital, Philadelphia. The dosage was computed by the indirect method employing the mathematical equation, spark gap multiplied by time, multiplied by amperage, divided by the square of the distance. The dosage varied according to the disease, but the first dose in all cases, excepting when destruction or depilation was desired, was always one-fourth skin unit to test the tolerance of the skin; and then subsequent doses varied between one-fourth skin unit weekly and one-half skin unit every two weeks. Thus far, no bad roentgen-ray effects have been obtained. This is attributed to the accuracy of the apparatus, and to the practice of prescribing boric acid ointment for one week preceding treatment.

Acne vulgaris was represented by 36 cases, 20 of whom have been cured and the remainder markedly improved. There were 7 relapses which occurred usually four to six months after completion of treatment. These were subsequently cleared up by a few additional treatments. The dose was one-fourth unit in 9 cases, and one-half unit in 27. The average number of treatments was fourteen.

Verrucae was represented by 30 patients, 26 of whom were cured clinically, one improved and 3 failed. The failures were limited to plantar warts. The dosage employed was two-thirds of a unit every two weeks, and it required an average of three treatments.

Tinea tonsurans was represented by 50 patients treated by the Kienböck-Adamson method with 100 per cent cures and no complications. The entire scalp was treated at one sitting, giving each of the five areas a skin unit, unscreened, except the face, ears and neck. Depilation took place in from two to three weeks, and hair returned in from three to six months.

Dermatitis papillaris capillitii was represented by 4 cases receiving an average of six treatments, all being improved but not entirely cured. Ten patients with sycosis vulgaris treated with roentgen rays resulted in 7 cures and 3 improvements. An average of nine treatments was given in these cases.

Superficial epithelioma of the basal cell type was satisfactorily treated by roentgen rays. Seventy-five per cent of the patients were cured, and the remainder were unimproved and had to be treated with radium. It was frequently noted that cases failing to respond to roentgen rays would respond to 10 to 50 mg-hr. of radium. Pruritus ani and

vulvae were favorably influenced, usually after the first, and certainly after the second roentgen treatment. About six treatments (one-fourth unit weekly) were required to remove all itching. True keloid failed to respond to roentgen rays in 6 cases.

A number of patients with tinea cruris, xanthoma tuberosum, lupus vulgaris, chronic itching and papular eruption of Fordyce and Fox were treated with roentgen rays with striking improvement. One case of ring worm of the nails was cured after twelve treatments of one-half skin units. In paronychia, roentgen therapy holds forth a most gratifying method of treatment. Ten such cases have responded very well to one-half unit every two weeks. The results obtained in psoriasis were rather disappointing. Although improvement occurs it is not unusual to have recurrences before treatment has been completed.

Lichen planus both of the ordinary type and the hypertrophic variety is frequently cured by roentgen rays. Nine patients were thus treated and 7 were cured. Eczema responds brilliantly to roentgen therapy. The chronic lichenoid eczema melts away before the roentgen rays. Sixteen such cases receiving an average of six treatments were all cured. One suffered a relapse four months after apparent cure and the condition was cleared up permanently after two more treatments of one-half unit. In eczema of the hands a series of 50 cases were treated with one-fourth unit for an average of five treatments. Thirty-two, or 64 per cent were cured and the remainder considerably improved. Of the total number 15 per cent had a relapse four to six months after apparent cure. Fifty more cases were treated with one-half unit for an average of five treatments. Thirty-six or 72 per cent were cured and the remainder improved. Of this last series only 5 per cent suffered relapse. It appears, therefore, that the one-half unit method yields a higher percentage of cures and a lower percentage of relapses but it requires twice as long to obtain the results by the one-half unit method as by the one-fourth unit method.

CLARK, JOHN G., and BLOCK, FRANK B. The treatment of uterine fibromyomata. *Am. J. Obst. & Gynec., St. Louis*, October, 1925, x, 560–570.

The authors present an analysis of all cases of myoma of the uterus treated during 1922, 1923 and 1924 in the Gynecological Department of the University of Pennsylvania Hospital, all other types of benign hemorrhage being excluded. There were 436 cases of myoma uteri during this three-year period; in 14 operation was refused or delayed on account of some contraindication; of the remaining 422 cases 267 (63 per cent) were subjected to operation, and 155 (37 per cent) were irradiated. Only 2 of the latter received roentgen treatment, the rest being subjected to radium rays. The tendency has been toward operation rather than irradiation; 58 per cent were operated on in 1922, 60 per cent in 1923 and 70 per cent in 1924.

The treatment of uterine fibromyomas should be undertaken only by those who are familiar with the operative as well as the irradiation method of treatment. The mortality from radium irradiation in properly selected cases has been nil; and satisfactory results will be obtained in 90 per cent of the cases after one treatment. The mortality of uncomplicated uterine fibroids subjected to operation is rapidly approaching the vanishing point and is nil in the present series. The mortality in complicated cases subjected to operation is 3 per cent, but the mortality of the entire operative series varies from 0.7 to 1.4 per cent, depending on the cases included. The mortality of the entire series of 422 cases irradiated or operated on varies from 0.47 per cent to 0.7 per cent, according to the method of calculation.

The end results of operation are satisfactory in about 95 per cent of cases. The mortality and morbidity of fibroid tumors of the uterus are usually due to complicating conditions.

COSTELLO, JOS. P. Radiation of the thymus in infantile eczema. *J. Missouri State M. Ass.*, October, 1925, xxii, 398.

Pediatricians have long noted the tendency of infants with eczema to develop asthmatic bronchitis. The author began a routine roentgen examination in all cases of facial eczema in infants having an asthmatic bronchitis and found that a number of these cases had an unmistakably enlarged thymus. Roentgen treatment of the thymus was found to have a direct effect on both the eczema and the asthmatic attacks. The technique of irradiation is not given. The results in 5 cases are reported. The usual physical findings in these cases were as follows: A tendency to obesity; a delay in development; a general adenopathy; enlargement of the tonsils and adenoids; a widening of the sternal dullness on percussion and a widening of the tracheal breath sounds. In none of these cases was there anything unusual in the laboratory examinations.

In general it was found that two roentgen treatments usually sufficed to clear up the eczema and stop the bronchial asthma. There

was slight recurrence in one or two cases. The conclusions are that the thymus is a *probable* cause of certain types of facial eczema, and that facial eczema and bronchial asthma in early infancy are each a part of one disease. A reduction of the thymus by means of roentgen rays is a means of improving and often curing this symptom-complex.

COTTENOT, PAUL. A case of multiple osteosarcoma of the skull and face. Presentation of roentgenograms taken before and after roentgenotherapy. *Bull. et mém. Soc. de radiol. méd. de France, Par.*, 1925, xiii, 48.

Complete cure from multiple osteosarcoma by means of roentgenotherapy is shown in the case reported, and excellent proof is given in roentgenograms. The following treatment was given: tension 200,000 volts; focal distance 40 cm.; filtration through 0.5 mm. of zinc and 1 mm. of aluminum; irradiation of two large lateral fields taking in the whole profile of the skull and face; 2,000 R per field or 4,000 R given in four days. The roentgenograms showed complete cure, the lesions having completely disappeared. The image of the profile was that of normal skull and face, and there were no abnormal features noticeable. The bone repair was perfect.

CRAIN, R. CARTER. Some factors in radium treatment. *Illinois M. J.*, February, 1925, xlvii, 110–112.

Each case requiring radiation treatment must be individualized. A given amount of radiation might restrain a growth in one case and produce no visible change in another. The tolerance and reaction of both the patient and the tumor must be taken into account.

The location as well as the nature of a neoplasm has an important bearing on the treatment. All deep-seated masses should receive intratumoral rather than external irradiation. A sufficient dose must be given to destroy the tumor cells. A large amount of radiation delivered over a short period of time does not have the same effect as a smaller amount delivered over a longer period.

FLATAU, W. S. Further experience with stimulative therapy by means of roentgen rays. *Monatschr. f. Geburtsh. u. Gynaek., Berl.*, June, 1925, lxix, 401–409.

The author reports the best results in women from twenty to twenty-six years old who are constitutionally of the asthenic type. Up to July, 1924, 49 such cases were treated and 24 were considered cured of their hypoplastic amenorrhea or oligomenorrhea. We do not know anything about the biological reactivity of dormant but potentially vital follicles. Despite this unknown factor, stimulative therapy should be administered in cases of retarded or diminished ovarian function, because it is the only procedure that causes recovery in a hitherto unheard of proportion of the cases.

It is emphasized that cases of absolute, not acquired, amenorrhea or the very severe types of oligomenorrhea, when in women older than twenty-eight, should not be subjected to the stimulative roentgen therapy. Such cases are not helped and serve to bring discredit on the whole method of treatment. Early pulmonary tuberculosis in young girls produces an amenorrhea and such patients should of course not be exposed to roentgen rays.

It is claimed that over-emphasis has been placed by Holzknecht and others on the argument that stimulative roentgen therapy may do more harm than good. It is of course necessary to have complete and skillful command of the technique of administration. The author employs a Veifa-Neo-Intensiv apparatus with direct current; thermion tube, filter 0.8 mm. Cu plus 0.3 mm. Al; focal skin distance 30 cm., field 9 by 12 cm., about 200 kv., 3 ma., one-quarter to one-fifth of a skin unit dose being administered at a sitting. The skin unit dose and the percentage depth dose is determined and controlled biologically and physically. In cases of infantile absence of function only a single dose is given.

The author has treated 21 cases of sterility due to hypoplastic-asthenic functional anomaly of the ovaries with roentgen stimulative doses. Of these 12 have since undergone pregnancy; 4 of these have aborted, 2 spontaneously in the second and fourth month, and 2 criminally. Eight of the women have delivered healthy children at term. These are briefly cited.

Roentgen stimulation of the spleen is effective in certain forms of polymenorrhea. One must, however, carefully select the cases for treatment. The author has confined his efforts to the small group of severe and intractable hemorrhages in girls and young women. Excluding heart cases and hemorrhagic diathesis, suitable cases can be selected which could hardly be due to any cause other than dysfunction of the ovary. During the past three years only 17 such cases of adolescent hemorrhages have been subjected to spleen irradiations. The treatment was delivered by a Neo-Intensiv apparatus, with direct current, 160 kv., 3 ma., 30 cm. skin focal distance, 9 by 12 cm. field, one-half to three-quarters of a skin unit dose. The results are so irregular and uncertain that a final conclusion is not permissible. In some

cases hemorrhage ceased on the first day; in others the hemorrhage remained as profuse as ever.

FRAZIER, CHESTER N. Angioma cavernosum; report of a case treated with radium. *Arch. Dermat. & Syph.*, October, 1925, xii, 506–508.

From a surgical point of view, it is difficult if at all possible to remove cavernous angiomas safely and successfully on account of their location and extreme vascularity. A report is given of a case in an Oriental child, having an extensive angioma cavernosum which appeared a few days after birth and rapidly enlarged. The child was four months of age when first treated. The angioma was located over the left side of the bridge of the nose and almost covered the left eye. The tumor was very soft and presented an ulcerated area at its lower outer segment. The overlying skin was the site of a superficial nevus vasculosus.

Ninety mg. of radium element divided among four tubular applicators, two containing 25 mg. and two 20 mg. each were distributed over the surface of the tumor in such positions as to permit the rays to enter the growth at different angles. The 25 mg. applicators were screened with 1 mm. each of silver, brass, lead and hard rubber. The 20 mg. applicators were each composed of two 10 mg. needles screened with 0.4 mm. of an alloy of density 8.7 and 1 mm. each of brass, lead and hard rubber. The applicators were placed 2 cm. distant from the skin surface. The surrounding area was protected by 1 mm. lead with 1 cm. gauze between lead and skin. A single exposure of twenty-three hours was given with all applicators in place.

This irradiation produced no visible superficial reaction, and the angioma after three weeks gradually decreased in size. In eight months the tumor had completely disappeared. Although some scarring remained, the cosmetic result is considered good considering the size and location of the angioma. At the lower margin of the scar was a small recurrence of the superficial vascular nevus which could have been removed had not the patient disappeared from the clinic at that time. There was no evidence that any damage had been done to the left eye.

FRICKE, ROBERT E. High voltage roentgen-ray therapy in gynecological practice. *J. Radiology*, August, 1925, vi, 304–306.

Two cases are described. In the first case a very large fibroid causing severe menorrhagia proved tractable only to massive doses of radium applied externally. The tumor was controlled at first by the radium, later its renewed growth and activity were halted by exposure for fourteen minutes to high voltage roentgen rays. Here fourteen minutes' irradiation effected as much as an enormous dose of radium was able to accomplish.

In the second case six minutes' irradiation relieved a severe dysmenorrhea and produced a menopause.

The radiation was produced by 240 kv., 40 ma., filtered through 1 mm. Cu and 1 mm. Al, skin focal distance 50 cm. No definite conclusions can be drawn from only 2 cases recently treated, but there is much encouragement in these results and much expectation for future benefit in gynecological work from the application of high voltage roentgen rays with the more powerful modern machines.

FÜRST, WALTER. Indications for radiation therapy in gynecology. *Schweizer. med. Wchnschr.*, Aug. 6, 1925, lv, 725–730.

This is a lecture in which stress is laid upon filtration, increase of depth dose and control of field size in relation to the treatment of gynecological conditions. Roentgen treatment is permissible in cases of true menorrhagia, but it should never be administered in metrorrhagias in the absence of a thorough palpation and a curettage. Treatment based upon an inadequate diagnosis may lead to grave injuries and possibly to damage suits.

There appears to be an important relationship between ovarian function and the symptom-complex of tuberculosis in the female. Temporary roentgen castration is often advisable as a therapeutic aid in tuberculosis.

GILMORE, M. E. Multiple myeloma syndrome in a child. *Texas State J. M., Fort Worth*, October, 1925, xxi, 358–362.

Multiple myeloma is a rare disease of bone characterized clinically by multiple, often deforming, bone lesions, severe intermittent pain and Bence-Jones protein in the urine. It is essentially a disease of adult life, occurring most frequently after the age of forty. The author presents what is believed to be the first reported case of the condition in a child. The disease began to develop at the age of eighteen months, the symptom at that time being a heightening of the right eyebrow. During the first two years of illness errors in diagnosis caused waste of opportunity in roentgenographic and laboratory study of the condition. The earliest roentgenographic study was made on account of gastrointestinal symptoms which were at that time the only pronounced symptoms; and the diagnosis was tuberculous spine. The blood picture was that of a mild secondary anemia but the presence of myelocytes was not

reported and no search was made for Bence-Jones protein.

A section was removed from one lesion and submitted to Dr. Codman's commission on bone tumors. The opinions of four pathologists were conflicting, but notwithstanding these diverse opinions the case has run true to the clinical pictures of multiple myeloma, with the one exception of age.

The roentgen-ray treatment has produced gratifying results in healing the lesions and relieving pain, but has not stopped new lesions from appearing. In giving the roentgen treatment, the chief aim was to give a large enough dose to produce healing of the lesions without injury to the patient. The treatments of the skull caused temporary epilation. The treatments of the back produced an erythema. The child has received in all about forty treatments during the past four years, ranging from one-fourth to 2.5 skin units, filtered through 4 mm. Al.

HEMPEL-JÖRGENSEN, P. Operations on some cases of fibro-myoma unsuccessfully treated with *x*-rays. *Acta gynec. scan.*, 1924, iii, 218–233.

A description is given of 5 cases of fibroids which were operated upon after futile treatment with roentgen rays, 3 of the fibromyomas being located submucously. It should be remembered that it is impossible to make an exact diagnosis of submucous fibroma in probably 50 per cent of the cases.

The experience of the author in one case would indicate that radium treatment is rather uncertain on a submucous fibroid.

HESS, JULIUS H. The treatment of pertussis by roentgen-ray. *Illinois M. J.*, September, 1925, xlviii, 215–219.

The author believes that the results both immediate and remote of roentgen-ray treatment in whooping cough should be given further study before the method is recommended for general use. Excessive exposure of young children to roentgen rays is dangerous, consequently the neighboring organs should be protected and only the minimal number of exposures necessary for relief are to be given.

Most of the cases have been treated by the following technique: 4 ma., 7 in. spark gap, 2 mm. Al, distance 14 inches, 5 min. exposure. In young infants the first treatment at least was given for a shorter period, usually 2.5 to 3 minutes. In no instance was the treatment repeated in less than five days, while in some the interval was as long as seven days. The number of treatments varied from one to four.

Treatments should not be given before the paroxysmal stage is reached because their chief function is to lessen the severity of the disease. In some of the cases there was a striking shortening of the course. This must be considered of secondary importance, however, and the treatments should not be continued with the aim of attaining such a result.

In 62 cases treated during the summer and fall, 27 showed very striking improvement. In 40 cases comprising the winter group, only 10 showed marked improvement following treatment with roentgen rays. These do not include a considerable number of cases in which the symptoms were ameliorated to some extent by the treatment. The negative results were approximately 25 per cent in the summer and fall cases and 47 per cent in the winter cases. There was observed a general improvement after roentgen-ray treatment in those cases developing secondary pneumonia.

It is to be remembered that the adoption of the roentgen treatment for pertussis as a routine method would require a change in the quarantine regulations in most cities to permit the removal of patients from their homes to places of treatment.

HOLFELDER. The present status of radiation therapy of breast carcinoma. *Med. Klinik*, 1925, xxi, 213–216; 255–258.

A general review is presented on the basis of about 100 references in recent literature on the subject. The analysis leads to the following conclusion:

It is a fortunate thing that we possess in modern roentgen deep therapy a method of treatment for inoperable cases of mammary carcinoma that holds out some promise for relief; but it cannot be too much emphasized that we are today not yet justified in associating in any way the essentially experimental procedure of radiation therapy with the well-developed system of radical amputation of carcinomatous breasts. We are today not justified in attacking an ulcerating breast carcinoma, which is radically operable, by radiation therapy without operation. It is also believed that we have not yet arrived at the point where the surgeon can sufficiently trust the effectiveness of postoperative irradiation to be induced to make the operation less radical or less thorough. On the other hand, one would be inclined to recommend the well-directed prophylactic pre-operative irradiation as practised by American workers with apparent success. "Let us hold fast to the fact that the best results have been obtained by surgeons who have followed a very careful

operative technique with effective support by well planned after-treatment with radiation."

HOLFELDER, HANS. Critical observations on the present status of radiotherapeutic research. *Med. Klinik*, March 6, 1925, xxi, 366–368.

Early observations on the effects of deep roentgen rays led to the hope that with improvement of the depth effect it would be possible to attack those deep-lying carcinomas which experience had shown to be roentgen-sensitive in the upper layers. This hope has today been completely fulfilled. However, there has been in many cases an erroneous belief that the influencing of various deep-lying carcinomas was tied up with the curability of cancers, in short, confused with the solution of the cancer problem. It hardly needs to be stated that we are still far from a solution of the cancer problem.

A consideration of all the arguments pro and con has led the author to emphasize very strongly that going above 220 effective kv. at the tube, or above 8 ma. constitutes no improvement in the technique of roentgen irradiation, nor does it offer hope of better clinical results. The aim of modern deep therapy as revealed by recent biological research is not to be accomplished by intense or massive doses, but is characterized by a conscious avoidance of injury to the natural defense powers of the body, with a simultaneous direct attack upon the disease focus.

The aim of the local distribution of ray doses is now also pretty well established by numerous animal experiments and clinical observations, as well as by the development of the method of deep therapy. The discussion of this subject is practically closed. There still remains to be determined the distribution of doses with respect to time interval. This question is at present the subject of intense research interest.

Taken all in all, it may be said that today the physical questions and problems of roentgen therapy, as well as those of radium therapy, are clarified to the extent that there is practically international agreement on the unit of measurement of the roentgen dose; and a certain unification appears possible in the general radiotherapeutic technique in the sense that the administration shall be along physiological lines and administered cautiously.

HOTZ, G. Roentgen treatment of mammary carcinoma. *Schweizer. med. Wchnschr.*, May 28, 1925, lv, 521–524.

The results in the Basel Clinic have been more satisfactory since the introduction of postoperative irradiation. There was a distinct improvement in results after the use of repeated mild irradiations, and these results have been further improved since the application of a single intensive irradiation over three fields. The number of cases subjected to intensive irradiation are rather small but the differences in results are quite pronounced. Moreover, a re-examination of cases treated with repeated mild doses has shown rather unsatisfactory end results.

The author has for the past five years irradiated the operation scar and the regional gland areas with 2 Sabouraud doses. There followed an intense erythema and frequently also an extensive blistering which required several weeks to clear up. Cases thus treated have practically all remained free of recurrence. Such a treatment can be applied but once as a repetition may bring on a roentgen ulcer.

The experience at the Basel Clinic would indicate that repeated extensive irradiation of the whole involved zone with mild doses does not favor a permanent recovery. The intensive irradiation is far from being able to guarantee cure as recurrences have been observed in the first year and later; but one fact is of significance, namely, those recidives that come to autopsy show a generalized bone carcinosis but relatively few recurrences at the site of the primary tumor. This leads to the reasonable assumption that the carcinomatous foci in the primary region were wiped out by the treatment.

JARVIS, D. C. Roentgen-ray therapy in the nonsurgical treatment of ear, nose and throat diseases. *Ann. Otol., Rhinol. & Laryngol., St. Louis*, September, 1925, xxxiv, 760–766.

A case is reported in a man aged forty, who was treated for an enlarged lingual tonsil with roentgen rays, 7 in. gap, 5 ma., 10 in. distance, 2 min. exposure. The patient volunteered the information that the right ear, which had been stuffy for ten years, was now clear and hearing seemed improved.

However, not all patients complaining of impaired hearing are benefited by the use of roentgen rays. This form of treatment was applicable only to certain types of cases. The type of patient in whom one might expect favorable results from the use of roentgen rays appears to be from that group between the ages of thirty and fifty, who are subject to frequent head colds and complain more or less of a constant catarrhal discharge from the throat and at times a stuffiness in the ears, and an accompanying impairment of hearing. In this group the throat ailment is prominent. It is suggested that the effects of the roentgen rays

in such cases are an action upon the blood supply of the irradiated areas.

KILLINGER, R. R. Dactylomegaly. *J. Florida M. Ass., Jacksonville*, July, 1925, xii, 6–10.

A bilateral affection, the only case reported, is described in a colored man aged thirty-three. The man was born with the present deformity as it now exists with reference to the digits involved, but they have grown as the rest of the body grew. The measurements show there is nothing in this case to be confused with acromegaly.

Roentgenographically there is marked enlargement of the fingers both in length and diameter. On the left hand the thumb and index fingers are involved. On the right hand a similar symmetrical hypertrophy is present involving only the thumb and index finger. These hypertrophied bones appear fairly normal in structure except for some thickening of the periosteum near their necks. There is also slight irregularity of the joint outlines. Study of the head in a lateral view with specific reference to the sella shows an essentially normal appearance.

WOLMERHÄUSER, OTTO. Castration and climacteric symptoms. *Monatschr. f. Geburtsh. u. Gynaek., Berl.*, July, 1925, lxx, 63–78.

In 1921 and 1922 the author observed 146 myomas; and 131 were irradiated, including 36 larger in size than a child's head. About 10 per cent of all the myomas were not suited to roentgen treatment and had to be operated on. Those that were subjected to roentgen treatment were in general favorably influenced; the hemorrhages ceased and after six to nine months the original tumor nodules receded to a fraction of their original size.

The results of roentgen irradiation in the treatment of so-called climacteric hemorrhages were even more unequivocal. All of this group of cases received roentgen castration. These cases numbered 134 in the two-year period under discussion.

The author considers temporary castration as advisable in cases of chronic inflammatory, usually gonorrheal, diseases of the genital adnexa in cases that have become weakened and anemic through hemorrhage. Such treatment is also desirable where the monthly influx of blood into the genitals irritates and prevents recovery. Temporary roentgen castration is also indicated in early cases of tuberculosis where the menstruations affect the general condition and also the pulmonary process.

There is only a difference in degree in climacteric symptoms, no matter if the ovulation is only temporarily or permanently inhibited by roentgen rays or the whole ovary is removed by operation. As a matter of fact, retaining the ovaries and removing the uterus alone is unable to prevent appearance of the climacteric symptoms. Uterus and ovary comprise a functional unit and a removal of one or the other must occasion functional disturbance.

Of tumors, the most important ophthalmologically are those of the hypophysis. Great experience and practice are necessary in recognizing small tumors because chronic endocranial increase in pressure may occasion similar changes, namely, broadening of the sella and erosion of the dorsum sellae and of the clinoid process. Moreover, tumors of the dura originating in the vicinity of the sella turcica may simulate hypophyseal tumors by producing erosions. Of importance to the ophthalmologist is that group of neoplasms which leads to destruction of the pyramidal process. Tumors of the brain, so far as they are localizable, are differentiable in a characteristic manner from those of the dura. The former lead to a thinning of the adjacent cranial covering, while the latter, even when of slight extent, occasion a local thickening of the bone. This is an important distinction.

Roentgen Therapy. In all tumors where operation has been unsuccessful, irradiation remains the ultimate recourse. Especially satisfactory is the frequent and characteristic arrest of space-filling tumors of the orbits. The author has observed in the case of operable tumors like those of the hypophysis that roentgen therapy has been effective, and in other cases where such treatment was ineffective. As is well known the cystic tumors are refractory to radiation therapy. In most cases there is no clinical or roentgenological evidence to indicate the nature of the tumor, consequently it is suggested that before operation is attempted a trial should be made to see if the tumor responds to radiation. There is no evidence as yet that such tumors are made less amenable to surgical treatment if it becomes necessary to submit them to operation later on.

In known malignant diseases, and especially inflammatory conditions, the indications for roentgen therapy are favorable. Large doses causing injury, and even medium doses, are not only unnecessary but definitely contraindicated. A tolerated dose of about one skin unit (repeated at intervals of about five to six weeks) has been found sufficient. One rule should be observed in the treatment of the various conditions where roentgen therapy is indicated, namely, favorable results are obtained early if at all, and that small doses will produce

whatever effect can be obtained. Pushing the treatment beyond these limits has never produced anything worth while.

BAUER, FRIEDRICH. Roentgen treatment of inflammations. *München. med. Wchnschr.*, Apr. 17, 1925, lxxii, 646–648.

The results of the roentgen treatment of inflammation are in many cases astonishing. From the changes observed in the blood picture after irradiation it seems clear that the defense forces of the body are stimulated by the rays. The same successful outcome can probably be secured by conservative treatment waiting for the body forces to overcome the infection.

During the past half year, over 100 cases of acute, subacute and chronic inflammations were treated by roentgen rays, the treatment being that recommended by Heidenhain, only 20 per cent of the skin unit dose being administered to the skin. No other treatment was given to these patients except the advice that the patient rest in bed or else rest the infected limb. Of these cases a pronounced retrogression in twenty-four to forty-eight hours after irradiation occurred in 15 cases. Three more required paracentesis to complete their recovery; in 23 others there was distinct improvement; in the remaining 59 the general condition did not improve and febrile reaction remained until spontaneous recovery was begun. It was often necessary to open the abscesses. Some of the chronic cases had of course been previously unsuccessfully treated by other methods before treatment with roentgen rays.

It appears that the roentgen treatment was especially successful in cases in which the lymph glands were affected or were in close vicinity to the suppurative process. Two cases are cited of abscessed lower jaws, one of which was treated by roentgen rays and the other as a control treated by the customary methods. The recoveries in both cases were identical.

BELOT, J., AND NAHAN, L. Considerations on the treatments of nevo-carcinomas. *Bull. de l'Ass. franç. l'étude du cancer., Par.*, 1925, xiv, 139–147.

A general discussion of the treatment of nevocarcinomas is given, with the conclusion that negative electrolysis is the best treatment available. The objections to various other methods are reviewed. In the surgical operation there is danger of metastasis. Penetrating roentgenotherapy often gives favorable results, but there are objections which make this method less to be desired than negative electrolysis. For extensive lesions and adenopathies, penetrating roentgenotherapy is probably to be preferred, or at least is less objectionable than in other forms of the carcinomas.

BORMANN, S. Treatment of acute eczema with roentgen rays. *Arch. f. Dermat. u. Syph.*, 1925, cxlix, 519–524.

It is believed that the roentgen therapy of acute eczema has a sound theoretical basis and deserves further study and elaboration. A report is given upon material collected during a period of eighteen years comprising 400 cases. Of these, 199 were observed for a long time after recovery. In this group of 199 cases, 96 are reported as cured. The treatment consisted on the average in two full doses given at intervals of four to six weeks. The dose was 4 H, skin focal distance 15 to 20 cm. For the treatment of lips, mammae and mucosa the dose was 3 H. By using medium and very soft tubes, filtration of the radiation may be dispensed with. A summary is given of 23 acute cases which have been treated in the past two years by improved roentgen therapy without the aid of any other treatment. Twenty-one of these cases have been released as cured. Two illustrative cases are cited.

BROOKS, H. L. Radium treatment of immature and incipient cataracts. *J. Ophth., Otol. & Laryngol.*, September, 1925, xxix, 349–357.

The author has been treating 9 cases over a period of two months to almost two years using 49.9 mg. radium element. The applicator consists of a specially designed brass and aluminum cup which holds five needles. The brass is of sufficient thickness to give practically complete screening of the primary beta rays. Gauze pads are used to fix the distance of the applicator at 5 to 8 cm. The eyebrows and cheeks are protected with 1 mm. of lead and the applicator is applied over the affected eye, the patient being directed to look straight ahead.

The dose varied between 25 mg-hr. and 200 mg-hr., depending upon the individual case. These treatments were repeated at weekly, semi-monthly and monthly intervals. Initial improvement was observed, but whether this can be maintained remains to be determined.

The application of radium properly screened apparently does no injury to the normal structures of the eye. Frequent treatments, especially at first, are essential and the opacifications of the lens diminish under the influence

of the radiation. The radium seems to have a selective action on the lens.

No difficulties will present themselves if a cataract has to be operated on after having been treated with radium.

CARTER, L. J. Spinal metastasis from breast carcinoma. *Canad. M. Ass. J.*, January, 1926, xvi, 48–51.

Carcinoma of the breast in women and carcinoma of the prostate in men are considered the most frequent primary tumors to show metastasis in the spine. Fifty-four breast carcinoma cases have been reviewed in this series. All had radical operation, and the diagnosis was confirmed by the pathologist. Many had pre-operative irradiation, and all operations were followed by roentgen therapy over the tributary gland areas. Twenty-one cases showed recurrence or metastasis distributed as follows: spine 7; lungs 7; cervical glands 5; skin at operation site 4; peritoneum 3; hip 2; liver 2; opposite breast one; axillary glands one. Recurrence or metastasis occurred in from three months to five years. Forty per cent of the cases developed metastases, and in one-third of that 40 per cent the metastases were in the spine. This indicates the prime importance of breast carcinoma as a precursor of metastases, and points also to the spine as the very frequent site for that metastasis.

A short summary is given of 4 case histories. The characteristic symptom which should draw attention to the spine when dealing with breast carcinoma is pain. This pain is bilateral in distribution. Long preceding any lesion that can be demonstrated by roentgen rays, this characteristic type of pain is almost diagnostic of beginning metastasis in cases of breast carcinoma. The lesion itself when sufficiently advanced to be demonstrable by the roentgenogram has a characteristic appearance. Two types of pathological change are noted. The osteoclastic process in which there is an absorption of lime salts and a consequent rarefaction with little or no loss of contour is characteristic of lesions in the lumbar and dorsal regions. The osteoclastic process in which there is alternate absorption and deposit of lime salts in contiguous areas is characteristic of lesions in the lumbosacral and sacroiliac regions.

The complication of spinal metastasis is sufficiently frequent to warrant a thorough preliminary roentgenographic investigation of the whole spine in all cases of breast carcinoma. The author's experience is that secondary carcinoma of the spine is usually uninfluenced by radiation, although striking results are occasionally reported by others.

COLE, PERCIVAL P. The treatment of inoperable cancer of the female pelvic organs. *Brit. M. J., Lond.*, Nov. 7, 1925, ii, 831–836.

A discussion is given of the general position and treatment of inoperable cancer of the uterus. It is believed that the general inoperability rate is about 62 per cent in these cases. A report is given of 263 cases of cancer of the uterus observed between 1919 and 1925. The number receiving radium treatment was 103, or 39 per cent of the total. The local and symptomatic benefit which follows immediately after treatment is most striking. Hemorrhage is not always checked and may, on the contrary, sometimes be caused by roentgen and radium treatment. A systematic irradiation of the pelvis with roentgen rays after local radium application by the vagina has been attended by encouraging results. The average length of life of those who died after radium treatment has been little greater than might reasonably be expected in untreated cases. Results are, however, undoubtedly improving. The dosage employed has been, comparatively speaking, small, the tendency being to determine an increased milligram-hour exposure by lengthing the time and not by increasing the amount of radium.

The author agrees with the opinion of Clark and Keene that "as matters now stand irradiation has unqualifiedly won its right to a place along with surgical means, for it has stepped into the inoperable breach with a hopeful assurance of a large alleviation of suffering and a minimum probability of cure."

MISCELLANEOUS

MIESCHER, G. Clinical features and pathogenesis of late roentgen injuries of the skin. *Schweizer. med. Wchnschr.*, Dec. 3, 1925, lv, 1111–1118.

One should distinguish clinically between the acute roentgen injuries occurring soon after irradiation and those which appear slowly much later and develop chronically. The acute form appears as a primary roentgen dermatitis progressing beyond the stage of erythema to erosion or necrosis and primary roentgen ulcer. The latter type of injury is usually exceedingly torpid, very painful and leaves behind almost always a condition of radiation atrophy with all the dangers of secondary late injuries.

The chronic type of roentgen injury, as distinct from the acute late symptoms, develops months to years after a previous roentgen dermatitis or even without the latter, upon an apparently intact skin. One must distinguish here between the changes directly related to

the roentgen irradiation and representing an end phase of the roentgen reaction, and the indirect changes produced by interference of other factors.

The direct changes, taken as a whole, comprise the picture of roentgen atrophy which is quite characteristic and easily diagnosed. In the milder stages one merely finds the occurrence of anomalies of pigmentation. The hair may be entirely absent or sparse, and then frequently unpigmented. In the affected skin areas there may be a few or numerous irregular telangiectases followed by the various grades of atrophy. A special type of skin injury has appeared since the introduction of hard-ray therapy, namely, chronic indurative skin edema. This change occurs most frequently in submaxillary and submental regions and the ears, but may occur anywhere else on the body.

The indirect changes are the ones responsible for the appearance of late roentgen ulcer. The radiation-atrophied skin presents a pronounced disposition to the formation of ulcer. The most insignificant trauma may produce extraordinarily severe effects. The atonic roentgen ulcer is fundamentally nothing less than the expression of an exhausted regenerative power due to heredocellular injury of the mechanism of cell-division.

It is demonstrated that the roentgen ulcer always develops at the site of a chronic, latent cell dystrophy which can always be demonstrated whenever there are symptoms of radiation atrophy (telangiectasis, leucomelanoderma, atrophy, sclerosis). It is also a possibility when the skin presents only the single sign of chronic pigmentation. This dystrophy may be the result of a single very intense irradiation followed by clinically manifest reactions. On the other hand, it may be the result of repeated irradiations that produced slight or no reactions. Among the physical factors the most important is the field size; and among the biological factors is the condition of the skin, especially inflammatory change and localization. The author's experience shows that dystrophic changes can be expected if the primary reaction reaches or surpasses a pronounced erythema with a dose of 1.3 to 1.5 skin unit doses (or 800 to 900 R) over the intact skin in small fields.

It appears that the doses recommended in recent textbooks for the treatment of dermatoses are too high, or at least not cautious enough. Extreme caution is necessary, especially in the treatment of pruriginous conditions where scratching may induce late roentgen symptoms, or in localities of the body subjected to maceration or mechanical irritation. Several typical cases of injury are described. In most cases of inflammatory conditions of the skin, the roentgen dose of 2 skin units through large fields should not be exceeded in a period of a year or even longer. The intact skin undoubtedly can stand a good deal, but except in special cases, like tumors, the total dose should not exceed 3 skin units.

It is not believed that the cases of late roentgen injury cited belong to persons unusually sensitive to the roentgen rays. It is believed, rather, that these reactions represent the general rule.

There are certain forensic aspects of the problem to be considered. The essential point is certainty as to the exact dosage administered. This necessitates calibration of the output of the roentgen machine and the use of correct filters and portals. It may be that a number of late roentgen injuries may be assigned to inexact dosage as distinct from gross carelessness in technique.

NADSON, G.-A., and PHILIPPOV, G.-S. Influence of the roentgen ray on sexuality and the formation of mutants in the lower fungi (*Mucor*). *Compt. rend. Soc. de biol., Par.*, 1925, xciii, 473–475.

The action of the roentgen ray in doses of ⅛ to 1.5 erythema doses was sufficient to cause a diminution of growth of *Mucor genevensis* and *Zygorbyncbus moelleri* and also to cause a more sensitive sexual function, reducing to a minimum the formation of zygotes. There was sometimes observed a deviation of sexual function in the sense of heterogamy; that is, the formation of sexual cells in the opposite manner. A depression of sexuality is also noted after exposure to emanations of radium. It may even totally suppress sexual function in *Z. moelleri*. The asexual reproduction is more resistant to the roentgen ray, however; the development of sporangia is also lessened by exposure to high doses. The development of the vegetative part of *Mucor* suffered less from irradiations than the sexual cells. There was also observed, under the influence of weak doses, separation of the culture of *M. genevensis* into two races which were definite mutants from the original culture. These characters were constant after twelve generations. These changes are definite mutants, similar to mutations observed in bacteria.

REISS, P. The comparative action of the roentgen ray and radium on the nucleus and cytoplasm. *Compt. rend. Soc. de biol., Par.*, 1925, xcii, 1403–1406.

Eggs of the sea-urchin were exposed to both radium and the roentgen ray for varying

lengths of time and the effect on fertilization determined. The radium was used in from 0 to 13.3 mg. doses and the roentgen ray in doses equivalent to 5 H per minute. It is shown that, in the case of radium, after the rapid death of the nucleus, the cytoplasm remains intact for a sufficient time to permit of the mechanism of parthenogenesis. In the case of the roentgen ray, on the other hand, the difference between abortion attributable to lesions of the nucleus and those of the cytoplasm is considerably less. The relation between the sensibility of the cytoplasm and the nucleus will be 18:1 for radium and 3.8:1 for the roentgen ray.

RIVIERE, CLIVE. The normal chest *x*-rayed. *Tubercle, Lond.*, May, 1925, vi, 382–383.

The normal chest roentgenogram is a roentgenogram of a normal chest, not merely the chest of a healthy individual. The lung fields under roentgenoscopy should show an even translucency and brighten equally on deep inspiration. The apices especially should be subjected to this test. The diaphragmatic movements (and also the movements of the ribs) should be free, and equal on the two sides.

The chest roentgenogram presents a central mass of shadow dividing up the comparatively clear lung fields on either side. A brief description is given of the central shadow, the lung fields, the lung roots and the arborisation.

In considering the normal chest roentgenogram the main object must be to proffer a standard of normality against which the appearances of disease may be tested. A mere statement cannot truly present this elusive entity; it must grow up from long roentgenographic experience. Even among the experienced, opinions often differ as to where the limits of normality should be drawn.

ROBERTS, W. E. Modification of the Sweet localizing apparatus. *Am. J. Opbth., Chicago*, June, 1925, viii, 470–472.

The Sweet localizing apparatus for the localization of foreign bodies in the eye has been modified by the introduction of rack and pinion adjustment of the vertical and anteroposterior movements of the ball localizer in front of the cornea. The object of the modification is to reduce as far as possible the various sources of error encountered in doing this branch of roentgenologic work. The variation of a millimeter often means the loss or saving of an eye, and a great part of the responsibility often rests on the roentgenologist.

It is claimed that possibility of error is reduced in three different ways by the modification suggested: (1) by substituting a rack and pinion for a sliding arrangement in making vertical adjustment; (2) by substituting the rack and pinion on the horizontal bar for the trip spring and catch on the old instrument. This arrangement allows two reductions of possible error, (*a*) that due to movement of the patient when the noise of the sudden spring release is heard; (*b*) permits of moving far enough back to allow any patient, no matter how long the eyelash, to blink the eye in a normal manner without interference; (3) a millimeter scale permits the operator to accurately move the horizontal bar to any distance, overcoming the possibility of loss of elasticity of the spring or variation in resistance due to friction.

SHELDON, ALBERT R. A simple and effective method for making positive film reductions from *x*-ray plates. *Radiology*, November, 1925, v, 437–438.

The miniature transparency is superior to the average print in many respects. The process used by the author is similar to that used in making lantern slides. The original roentgenogram is illuminated and the reduction made with a 5 by 7 lantern slide camera upon which is placed a 5 by 7 back. The film upon which the reduction is to be made is placed in a cut film holder and the original reduced to 4 by 5 inches. By using Eastman commercial cut film, they may be placed in the ordinary frames and developed and fixed in the roentgen-ray tank.

There is a constantly increasing use for positive film reductions such as those described above.

BAGG, HALSEY J. Hereditary abnormalities of the viscera. 1. A morphological study with special reference to abnormalities of the kidneys in the descendants of *x*-rayed mice. *Am. J. Anat.*, Nov. 15, 1925, xxxvi, 275–303.

A description is given of a series of visceral abnormalities that have occurred in the descendants of a group of roentgen-rayed mice, the study being based on an examination of over 1800 autopsies. The abnormalities are chiefly disturbances in the structure and functions of the excretory organs. These defects are associated with abnormalities of the testis and liver, as well as such relatively external features as blindness and various morphological disturbances of the limbs.

Inherited abnormalities of the viscera have been noted in the descendants of a group of mice treated with comparatively light doses of unfiltered rays on five successive days. The visceral abnormalities are mainly defects of the kidney which may vary from a partial to nearly complete atrophy of one kidney, to

the congenital solitary kidney condition, and to complete absence of both kidneys. The right or left kidney may be affected with equal frequency and there is apparently no sex difference in this respect. Animals with the congenital absence of both kidneys are born alive and are apparently of average weight and development in other respects. They live about twenty-four hours.

Congenital hydronephrosis and polycystic kidneys are apparently associated with embryological factors that produce the suppression of kidney development. Blindness and various defects of the limbs, especially club feet, are closely associated with abnormalities of the kidneys. In the animals reported upon there was apparently a general tendency to disturbances in embryonic development.

Embryological studies of young from strains with a high incidence of visceral abnormalities have shown that these defects are associated with blood extravasations, especially in the liver and testes, which are similar to those extravasations closely associated with the production of blindness and club feet. Selection has greatly increased the number of animals with visceral abnormalities in the experimental lines. The visceral defects are definitely inherited, recessive to the normal, and when considered as one of the manifestations of the general tendency to abnormal structure they approach the mendelian expectation in behavior.

Bastings, L. The decay constant of radium emanation. *Proc. Cambridge Phil. Soc.*, 1925, xxii, 562–566.

Comparisons were made of a radon tube with a tube of Ra B + C and a standard Ra tube. The mean of 17 determinations gives the half period of radon as 3.833 days, corresponding to a decay constant of 0.1808 per day with an error probably not greater than 0.2 per cent.

Bucky. Purely surface therapy with extra soft roentgen rays. *Münchcn. med. Wchnschr.*, May 20, 1925, lxxii, 802–806.

It would appear that extra soft roentgen irradiation, such as can be produced with special rays and apparatus, may very well revolutionize surface therapy in view of its safety and economy. Experience, however, will have to demonstrate to what extent new and better results can be attained.

A review of experience in roentgen therapy shows clearly that soft rays are peculiarly effective against the superficial layers of the skin. Further analysis of this action indicates that the ordinary soft rays from a roentgen tube still contain enough hard components to injuriously affect the deeper dermal layers, whereby nourishment is interfered with and profound effects upon the skin result. In other words, the customary soft rays are too hard for skin therapy.

The ordinary roentgen tube is made of glass, the constituents of which absorb out a good deal of the softer rays. The author therefore introduced a Lindemann window in a roentgen tube, which window being made of glass of lighter elements permitted very much softer rays to escape. The maximum of soft rays was produced of course at relatively low voltages. As would be expected, these soft rays have very little penetrating power and can be effectively absorbed by thin layers of paper, leather or celluloid. Preliminary experiments with these rays in a few skin conditions indicate a possible field of usefulness for these extra soft rays.

Buschke, A., and Sklarz, Ernst. The histological findings in the skin of mice and guinea pigs irradiated with extra soft roentgen rays; keratitis in a guinea pig eye following extra soft irradiation. *Münchcn. med. Wchnschr.*, May 15, 1925, lxxii, 806–807.

These experiments were undertaken at the request of Dr. Bucky. In all, 7 mice and 3 guinea pigs were irradiated on various portions of the skin or over the eye with extra soft roentgen rays obtained from a Coolidge tube with a Lindemann window. The study consisted in examination of serial sections stained with hematoxylin-eosin according to van Gieson for elastic fibers and fibrin.

The mice received skin treatments with radiations of the following factors: 7 kv., 10 ma., 9 cm. skin focal distance for 15 min., up to 18.4 kv., 15 ma., 20 cm. skin focal distance for 30 min. Pathological findings were observed with the higher doses. There was a hyperkeratitis with fibrosis of the individual epithelial layers. Similar observations were made on the guinea pigs. Where the voltage was down to 8 kv. an exposure of 5 to 15 minutes showed no striking results, except in one guinea pig there was a definite roentgen injury produced on the site of irradiation, namely, epilation followed by a small ulcer that was apparently not painful.

Speaking in general, it may be stated that extra soft rays produced histological changes only after prolonged exposure and these changes could be regarded as pathological only with reservation. More pronounced reactions occur after exposures to rays generated by 12 to 13.6 kv. for longer periods. No statement can be made yet as to a possible difference between immediate and deferred effects. The essential point that is brought out is that pronounced

effects are produced on the skin by voltages that are very much lower than the customary ones used in modern therapy, and in addition this effect is in general limited entirely to the epidermis.

A guinea pig received radiation for 15 minutes upon the right eye with 18.4 kv., 15 ma., 17 cm. skin focal distance. A distinct superficial keratitis gradually developed. There was also a visible wandering of pigment epithelial cells through the ciliary epithelium but the possible significance of this is unknown. This is of interest in view of the fact that heretofore the experimental production of keratitis in animals required very much harder rays.

CHIZZOLA, GIULIANO. Goetsch's test in the roentgenotherapy of Basedow's disease. *Arch. di radiol.*, July–Aug., 1925, i, 645–651.

Goetsch found that patients with hyperthyroidism have a hypersensitiveness to adrenalin, and his test for hyperthyroidism consists in injecting 0.5 c.c. 1:1000 adrenalin solution. Normal subjects show no reaction to this injection but patients with Basedow's disease show increased pulse rate and blood pressure, both maximum and minimum, and subjective symptoms consisting of tremor, asthenia, restlessness, feeling of oppression, and sometimes pallor, sweating and increased diuresis. The outcome of the test gives indications for treatment, and as the condition of hyperthyroidism improves the test gradually becomes negative. A number of authors have declared that the test has no physiological basis but Tarnanceanu reported that it is a rational biological reaction by means of which the patient can be followed up.

Chizzola tested it on 12 patients with Basedow's disease. He divides his patients into 4 groups: (1) those in whom the test was clearly positive with characteristc objective and subjective signs and who responded to treatment quickly and brilliantly; (2) those in whom the test was positive and who responded to treatment like the first group, but in whom the clinical symptoms reappeared and the positive test returned. They were given a second roentgen treatment with success; (3) patients with weak or slightly positive test who after a less prolonged treatment than that of the first two groups became negative to adrenalin with improvement in clinical symptoms, and (4) patients with Basedow fruste who showed a negative Goetsch test and were not given roentgen treatment although they demanded it for the reduction of their goiter.

He considers the test partial when the pulse and blood pressure are not increased but the subjective symptoms are positive. In the positive cases, the pulse and blood pressure increase within a few minutes after the injection and the rise persists for twenty to thirty minutes. In cases with very rapid pulse and very high pressure the increase is less marked, but the subjective symptoms are very severe. He thinks Goetsch's test is an excellent means of diagnosis in hyperthyroidism and a guide in treatment.

DEBUYS, L. R., AND SAMUEL, E. C. Growth of the heart; roentgenographic observations. *Am. J. Dis. Child.*, September, 1925, xxx, 355–358.

Studies have been made of children up to the thirty-ninth month of age. Roentgenograms were taken within twenty-four hours after birth and thereafter every three or six months. In this study there were 623 observations made on 400 persons, only normal hearts being included. All roentgenograms other than true anteroposterior ones were discarded.

There are two interesting changes which take place in the position of the apex beat as the individual grows: (1) the apex beat which at birth is in the fourth intercostal space is found later in life to be in the fifth intercostal space; (2) the apex beat which is outside the nipple line gradually changes to within the nipple line.

The shape of the heart normally continues to be the same during the growth and development of the individual up to thirty-nine months. The size of the heart shadow increases during the growth and development of the infant without change in the type of the shadow. The change in position of the apex beat is gradually toward the median line, which is due to a more rapid growth in the size of the thorax than in the size of the heart. The change in the position of the apex beat vertically is gradually downward, which is due to the more rapid increase in the size of the thorax. During this period, the shadow of the large blood vessels above the heart increase materially in length and does not appear to have any disturbing influence on the growth or position of the heart. In many individuals of the series in this study, certain shadows appear in the thorax which maintain their identical position in relation to the heart shadow as growth and development takes place, which is considered an additional argument that the heart does not rotate.

DEFOE, O. K., AND NIPPER, W. W. Total intensity of scattered roentgen radiation. *Nature*, 1925, cxv, 607.

A Coolidge tube with a molybdenum target, which was operated at about 5 ma. and 25 kv., peak, was used in a room $22 \times 25 \times 10$

ft. high. The tube was located about 2 ft. from one side and equidistant from the ends of the room. The effect of the radiation on a photographic film placed about 50 cm. from the tube and on a roentgenoscope indicates that the intensity of the scattered radiations inside the room is nearly of the same order as that of the direct radiation.

FREEDMAN, A. O. Anatomical note on a possible source of error in *x*-ray findings of the normal vertebral column. *Canad. M. Ass. J.*, January, 1926, xvi, 44–47.

The body of each vertebra normally has a vein or veins of appreciable size traversing its center horizontally. Occasionally this vein persists as a large vessel even in the adult. This vein may be of such size as to cause a fairly large channel through the center of the body of the vertebra. This normal channel will cause a definite fissure, complete or incomplete, in the body of one or many of the vertebrae. Such channels will show in the roentgenogram as horizontal transparent clefts through the centers of the vertebrae, and these transparent clefts must not be confused with fracture or any other pathological condition.

A case is described in a man aged twenty-five, the roentgenogram of whose vertebral column showed these peculiar markings. Post mortem examination gave the opportunity to confirm the above conclusions.

HAARDT, WILHELM. A "radium clamp" for use in the mouth, throat and larynx. *Med. Klinik*, June 5, 1925, xxi, 856–857.

The clamp is actuated by a spring and grips the radium tube either horizontally or vertically. The whole apparatus is fixed to the desired area by means of small hooks or teeth which grip the mucosa. For the sake of safety, silk threads are tied to the radium tube and the clamp.

The author has had occasion to use this clamp extensively and observed that the injury produced by the clamp is insignificant.

HOLBEACH, C. H. The Potter-Bucky Diaphragm. *Brit. J. Radiol.*, October, 1925, xxi, 159–167.

In spite of universal use very little actual information is available concerning the best methods of applying the Potter-Bucky diaphragm in every-day routine. The purpose of this paper is to clear up certain misconceptions which are prevalent and also to suggest how the factors of grid speed, exposure, and frequency have their bearing upon Potter-Bucky technique.

The correct grid proportions were at first arrived at empirically. The present form of commercial diaphragm is capable of cutting out as much as 90 per cent of diffuse radiation. Theoretically, maximum depth of lead strip and minimum spacing will produce maximum absorption of diffuse radiation, but practical difficulties make it necessary to adhere to the present form of the apparatus. It would be difficult to improve upon the best of the modern grids without imposing limitations upon their application for general purposes.

One of the outstanding advantages of the Potter-Bucky diaphragm is that greater latitude is allowable in the timing of exposures. This permissible increase in exposure has usually been considered due to the absorption of radiation by the grid, the aluminum top, and the air space between the patient and the film, but a consideration of these factors makes it evident that the explanation must lie elsewhere. In the average diaphragm total grid movement is 3¼ in. and provided that the grid moves not less than ½ in. during exposure there will be no visible sign of grid lining in the resultant roentgenogram.

In the Potter-Bucky technique one must consider the periodic effect of the grid itself. An exact image of the lead strip will be recorded on the film if the roentgen-ray periodicity is similar to the rate at which the strips pass a given point. This condition is not met with in practice. Nevertheless there will be at some point a coincidence of the tube periodicity with that of the grid. This cannot be entirely eliminated because the grid speed is a variable factor. If the latter were synchronous or at least synchronized with the roentgen-ray periodicity the difficulty could be solved. Grid lining is determined by the relationship of grid periodicity to roentgen-ray frequency and is absolutely independent of exposure time. At optimum speeds for a given grid construction, the lining tends to become so evenly distributed that no noticeable shadow is thrown on the film.

The ideal to be aimed at is the reduction of the space factor in order to reduce the distance between the body and the film to an absolute minimum. Not only will the range of diaphragm work be increased thereby, but the distortion at present obtained in the roentgenography of the pelvic regions will be lessened. The diaphragm will be applicable to the roentgenography of all extremities without the use of intensifying screens. These aims may be realized by (1) reducing the thickness of the grid and keeping the ratio of spacing to strip depth as low as possible; (2) lessening the clearance between the aluminum top and grid and between the

grid and film, and (3) by the use of curved aluminum cassettes.

ITCHIKAWA. Curiegraphy of experimental tumors by intravenous injection of serum charged with emanation of radium into the rabbit. *Bull. de l'Ass. franç. pour l'étude du cancer, Par.*, 1925, xiv, 193–195.

By injection of serum charged with the emanation of radium into the ear vein of rabbits, it was possible, by curiegraphy, to clearly distinguish experimental tumors, especially malignant tumors. Benign tumors (papillomas and fibro-chondromas) did not give curiegraphs after such injections. There is no danger to the animal from the charged serum. These observations are of particular importance in the diagnosis of malignant tumors and their metastases. They may also be employed in diagnosing inflammatory tumors (granulomas).

KAYE, G. W. C., and HIGGINS, W. F. An easily manipulated *x*-ray unit for the examination of material in quantity. *Brit. J. Radiol.*, October, 1925, xxi, 168–171.

A portable roentgen-ray unit has been designed which permits the rapid and easy manipulation of material and affords complete protection for the operator both from roentgen rays and high tension leads. A rotating hand switch is the only control on the apparatus which can therefore be put in the hands of an operator unexperienced in roentgen-ray manipulation.

The apparatus is intended for the physical laboratory.

KNOX, ROBERT. The investigation of the movements of the heart by the use of the slit diaphragm and the moving film. *Brit. J. Radiol.*, October, 1925, xxi, 142–158.

An apparatus was constructed along the principles outlined by Reider and Rosenthal and later by Crane. There was a tube box with a mechanism for accurate centering and in front of the box was fitted a cap in which was placed a sheet of lead containing a horizontal slit 10 by 3 cm. This aperture was sufficient to allow a fairly large beam to emerge and yet not large enough to give an exposure to a big area of skin on the back of the patient. The latter stands on an adjustable platform placed in front of the tube container. In front of the patient is a vertical stand holding the horizontal slit or slits. A fluorescent screen is first used to determine the position of the heart and is later displaced by a moving cassette. An accurately constructed film moving mechanism is employed.

Preliminary experiments indicated that the periodicity of the tube current produced characteristic markings upon the film. If the combination of high tension transformer and Coolidge tube is used it is essential that there be perfect synchronism between the heating current and the current through the tube.

When the horizontal slit is placed in front of the chest of the patient so that the edge of the slit to the left projects clear of the heart shadow and the film is moved slowly in a vertical direction in front of the slit for a few seconds, a record of the movement of the edge of the heart is obtained. This resembles in many points of detail the tracings obtained by the use of an electrocardiograph and the pulse tracings from the sphygmograph. If the horizontal slit is wide enough to cover the transverse diameter of the heart a record of the movements of the right and left edges of the heart will be presented. The record of the right side when taken low down is that of the right ventricle, and on the left side that of the left ventricle. It is usual, however, in the majority of cases when placed for a demonstration of the left ventricle for the right auricle to be shown. The amplitude of movement is seen to be much greater on the left side than on the right, and if the graph is examined carefully it will be noted that the two records are not synchronous, there being a slight difference between the appearance of the diastole and systole movements of each.

The ventricular movements are worthy of critical study and when compared with the electrocardiogram and the pulse tracings it will be found that a comparable record is obtained which gives practically all of the information afforded by the other two methods, and more. Analysis of the complete series of curves shows that the breadth of the heart can be measured because both the diastole and systole movements are shown.

If a film is examined there will be seen on either side of the actual heart lines a number of secondary lines. The records from different patients show considerable variation in the degree of lateral movements of these lines. These are caused by the transmitted impulses of heart movement upon a buttress of tissue formed by the pleural pericardium and lung substance and particularly by the bronchial trunks.

By the use of the method it is possible to measure accurately the transverse diameter of the heart in any of the levels of the cardiac shadow commencing at the arch of the aorta and passing down to the apex.

The additional information given by the roentgen-ray method which is unobtainable

from the electrocardiogram is listed as follows: (a) it is a faithful record of the actual movements of the pulsating heart; (b) the transverse width of the heart can be estimated directly from the tracing; (c) the width of the organ in systole and diastole is equally well estimated, and the difference between the two gives a rough estimate of the tone of the heart and its contractural power; (d) the method might also be used in the physiological investigation of the action of the heart and of the effect of drugs upon it.

It is suggested that the method may also be used for the investigation of the expansile movements of the aorta and aortic aneurysm; but it need not be necessarily confined to the heart and aorta, for movements of the diaphragm, stomach, duodenum and colon may also be recorded in a similar manner.

KOTTMAIER, JEAN. The blood shift during deep irradiation—a factor in dosimetry. *Med. Klinik*, 1925, xxi, 1265–1266.

The existence of a blood movement toward the irradiated area during intensive irradiation of some duration is based on the regular observation in patients of definite decrease in blood pressure following irradiation, together with the findings made with the capillary microscope. It is pointed out that radiation dosimetry in deep therapy has up to now not taken into consideration the individual factor which involves a shift of the blood toward the irradiated zone, which may account for the variability of the blood changes and the general reaction. These redistributions of the blood supply are conditioned by the production of acid components especially in the serum in the irradiated area which are followed by capillary dilatation, decrease in blood pressure and slowing down of the current. Th is physiological factor is rather difficult to determine accurately but should be taken into consideration, at least by those practising the method of the Opitz school, who irradiate the whole body. With the increasing appreciation of the general reaction after gamma ray treatment this method must gain in importance.

KROETZ, C. The biochemistry of irradiation. III. Influence of heat radiation on blood reaction, alkali reserve and mineral composition. *Biochem. Ztschr.*, 1924, cliii, 165–172.

Four men were subjected to heat and light baths. Alveolar CO_2 tension decreased 2.8 to 8.8 mm., while the alkali reserve remained unchanged. The pH of the blood increased about 0.02 to 0.077. Total solids, protein, hematocrit values and chlorides increased, while sodium increased in some cases and decreased in others. Fluid rich in protein and NaCl leaves the blood and goes to the tissues. In comparison with irradiation with ultraviolet and roentgen rays, heat radiation causes no initial acidosis or anion deficit; nor is there change in the ratio of ions: (K) (PO_4) to (Ca).

LAPENNA, MARINO. Histological findings as to changes in the development of the bones after experimental irradiation of the testicles with varying doses of roentgen rays. *Arch. di radiol.*, Jul-y-Aug., 1925, i, 653–665.

Irradiation of the testicles of young rabbits, with large doses, caused intense destruction of the tubules; this destruction began in five days and reached its maximum in ten days. At first only the less mature cells (spermatogonia) were affected, but later the more mature ones were also involved, and even Sertoli's cells were changed. After a month repair of the lesions began and in three months it was far advanced but not yet complete. The interstitial tissue also participated in the destruction, being very greatly reduced and at some points even having disappeared at the time when the lesions of the tubes were most extreme. At a later period the interstitial tissue proliferated and increased in volume.

Even irradiation with small doses was followed by destructive lesions particularly of the spermatogonia and spermatocytes. These lesions were repaired rapidly and the repair was accompanied by an enormous proliferation of the interstitial tissue.

Irradiation of the testicles with large doses was followed by changes in the development of the bones, consisting not so much in a change in length as in a slight enlargement of the epiphyses and a persistence of the diaphyso-epiphyseal space beyond the normal period, from increase of the epiphyseal cartilaginous layer and with irregular structure of a spongy type of the bone layer, into which tongue-shaped cartilaginous processes penetrated. These lesions are similar to those of experimental rickets. Even irradiation with small doses was followed by changes in the bones similar to but less intense than those after large doses. The bone lesions seem to depend essentially on a lack of inhibition of the growth of cartilage and a defective stimulus to enchondral osteogenesis. The bone lesions were observed in cases where the dose of rays had been so low as to cause only slight changes for a short time in the germinal cells and an intense proliferation of interstitial tissue.

Irradiation of the testicle with large doses was followed by degenerative changes in the thymus. This relation between the testicle and thymus must be taken into account in the interpretation of the bone lesions.

MAUBERT, A., JALOUSTRE, L., and LEMAY, P. Influence of radium on the catalase of the liver. *Compt. rend. Acad. d. sc., Par.*, 1925, clxxx, 1205–1207.

As has been shown with the bromide of thorium X, it is here shown that radium has a paralysing effect on catalase when used in strong doses, and an activating effect in weak doses. The α-rays are the most active, the β and γ being much less effective, in which respect radium differs from thorium X.

MOORE, R. B. Commercial production of radium, mesothorium and helium. *Indust. & Eng. Chem.*, February, 1926, xviii, 198–211.

In pitchblende the radium is in equilibrium with uranium and therefore the mineral contains a maximum amount of radium in proportion to the amount of uranium. Up to 1912 the principal sources of radium were the pitchblende of Joachimsthal and the autunite of Portugal. From 1912 to a few years ago the carnotite deposits of Utah supplied most of the world's supply of radium. In 1922 the radium ores of the Belgian Congo were developed to the point of production. These deposits are extremely rich, the selected ore which is sent to Belgium averaging nearly 50 per cent uranium oxide (U_3O_8). As a result only a relatively small amount of radium is now extracted outside of Belgium.

In treating any radium ore the process to be selected is dependent upon a number of factors. The type and grade of ore, the cost of chemicals, the plant space available and time desired for a complete cycle, etc., all have to be considered carefully. The question of recovery is more important in connection with radium ore than possibly any other ore that the metallurgist has to handle.

The crude sulphates may vary widely in radium content, from 0.25 mg. radium per kilogram to as much as 7 mg. radium per kilogram. In refining the crude extract the sulphate is reduced to sulphide as the radium barium sulphide. This is dissolved in pure dilute hydrochloric acid. Sometimes the crude sulphate is converted to the carbonate and then to the bromide. Either the bromides or the chlorides are then subjected to a process of fractionation. It takes a considerably larger number of fractions of the chlorides than of the bromide series to obtain a definite concentration. The object of the fractionation is to crystallize out the barium impurities. The barium chloride solution in each vessel is evaporated to such a concentration that on cooling one half of the barium chloride crystallizes out. The liquor is siphoned into the next evaporator in the series and the process repeated. This procedure continues all the way down the series. After a continuous series has been established fresh liquor may be introduced each day in the first evaporator, the crystals going in one direction, getting richer and richer in radium and the solution going in the other direction getting poorer in radium until after three or four crystallizations it is discarded. After a certain degree of concentration the last trace of lead is removed and the chlorides are converted into bromides and transferred for further fractionation in the laboratory because the bulk of crystals has by that time been very much diminished. Starting in the plant with a concentrate containing 1 mg. radium per kilo, ten or twelve bromide fractionations will give a product containing 1 to 2 per cent radium bromide.

Mesothorium is mentioned but the method of its production is not given. The production and handling of helium for airships are described at length.

MÜLLER, ERNST. Blood pressure reducing effect of radium baths and radium emanation. *Klin. Wchnschr.*, Dec. 17, 1925, iv, 2477–2478.

The relations of gout to arteriosclerosis led the author to take measurements of blood pressure amongst patients taking radium baths, and controls. The patients usually complained of pains in the extremities and joints, associated with short windedness. Their ages ranged from thirty-seven to seventy years. Cases with endocarditis or organic heart lesions were excluded from this study. Measurements of blood pressure (systolic and diastolic) were taken under uniform conditions, and it was found that there was regularly a decrease in the systolic pressure of 20 to 25 mm. on the Riva-Rocci sphygmomanometer after exposure to the radioactive bath. This diminution in pressure is not ascribable to the temperature, salt content and stimulation of the bath, for the same effect was produced upon patients who had spent several hours in a radium emanatorium without bathing. The higher the original pressure, the more striking was the response.

An illustration of this effect is given briefly in the citation of a case.

NEIHARDT, DEO. The effect of radium and roentgen rays on pathogenic fungi (*Sporotrichum beurmanni* and *Trichophyton gypseum*), *Dissertation, Zurich*, 1924, pp. 18.

The pathogenic fungi, *Sporotrichum beurmanni* and *Trichophyton gypseum*, were found to be sensitive to radium and roentgen rays. The spores were less sensitive than the vegetative cells. Irreparable injury is done to both the vegetative and spore forms by twelve hours' exposure to the radiations. Germinating spores are more sensitive than resting spores. A radiation stimulation could not be observed. These radiations are regarded as of value in diseases caused by the above organisms.

PASSOW, ARNOLD, AND PAULI, W. E. Experimental studies on the effect of roentgen rays upon the normal and infected rabbit eye. *Klin. Wchnschr.*, Nov. 26, 1926, iv, 2292–2295.

A bactericidal action of roentgen rays (against staphylococci and *Bact. coli*) could be demonstrated at a distance of 40 mm. between the bacteria and window in the cathode tube, provided sufficient time of exposure was given and the radiation energy was great enough. The effect of the cathode rays upon staphylococcus pus can extend into the interior about 0.20 mm. but a pronounced effect was found only for a distance of 0.025 mm. below the surface.

The normal rabbit cornea is affected in the same manner by cathode rays as by intensive ultraviolet light. The cathode rays are completely absorbed by the cornea and no injury is produced in the interior of the eye. This is also true for secondary roentgen rays. An experimentally produced corneal ulcer may be cured by cathode rays provided there is no deep purulent infiltration of the tissue. The application of cathode rays to the eye for therapeutic purposes is not advisable for the present because the necessary dose produces a conjunctival inflammation and a temporary injury of the normal cornea. Creeping ulcer of the cornea, for instance, has better prospects of cure from ultraviolet light therapy. It would appear that a therapeutic application to other parts of the body would be of use only where the condition was superficial or where it could be exposed to the surface and put within reach of the cathode rays.

These are but preliminary results. Further experiments will be necessary for a final verdict as to the therapeutic possibilities of cathode rays. It may be that such rays of greater velocity may have a greater penetrability. There is evidently a parallelism between roentgen rays and cathode rays in the injuries produced in irradiated tissue by the too soft radiations. The experiments cited above were done with the only tube available which unfortunately was unable to produce sufficient hard rays.

PIERGROSSI, LAMBERTO. The radiosensitiveness of cancer in relation to cytodieresis. *Arch. di radiol.*, July–Aug., 1925, i, 529–585.

Piergrossi concludes that there is no such thing as a cancer dose. The sensitiveness of a tumor to rays does not depend on the usual histological classifications but solely on the proliferative power of its cells; its sensitiveness decreases as the proliferative power decreases until it reaches a minimum which is that of the tissue from which the tumor originates. The index of reproductive power is furnished by the number and morphology of the cells involved in karyokinesis. From the point of view of radiotherapy cancers may be divided into three classes: (1) those with very high proliferative capacity and very high radiosensitiveness, characterized by very numerous and highly atypical karyokineses, many of them abortive, accompanied by monstrosities and conspicuous cellular degeneration; (2) those with high proliferative capacity and high radiosensitiveness, characterized also by very numerous karyokineses, but less atypical and lacking monstrosities and cellular degeneration; and (3) those with slight proliferative capacity and slight radiosensitiveness characterized by the rarity of karyokinesis.

In the life of the cell the period of greatest sensitiveness to irradiation is the period of cytodieresis. The action of the irradiation is chiefly if not exclusively, on the nuclear chromatin of the tumor cell and not on its stroma. According to this reasoning the most important factor in the dosage is not the quantity but the time. The irradiation ought to continue during an entire period of mitosis, so as to act on the nuclear chromatin during the whole time that it is involved in division. In all probability, judging from various figures given, the period of karyokinesis is about sixty minutes, rather less than more. Ordinarily fractional irradiations last about thirty to forty minutes and that seems to be sufficient to arrest karyokinesis, unless it is already in anaphase when the irradiation began. It seems that it is sufficient to irradiate a cell during the metaphase to destroy it. According to this theory, irradiation should always be prolonged and in fractional doses, as small, repeated doses act more intensely on the life of the cell than a large dose given in a short time.

By this method the whole time of irradiation should be prolonged and this time divided into a series of irradiations spaced in such a way that a single series lasts ten days or more. It must be remembered that not more than a skin erythema dose must be given on any one field, nor must a second skin erythema dose be given for some days. Therefore the time for giving an erythema dose must be prolonged either by stronger filters or by lengthening the distance between the tube and skin. The author finds that the best filter is one of 0.5 mm. of zinc and 2 mm. of aluminum and that there are certain disadvantages in changing this filtration, so that practically the best method of prolonging the time is to increase the distance. With a filter of 0.5 mm. of zinc and 2 mm. of aluminum and a target skin distance of 24 cm. the skin erythema dose is attained in an average time of 35 minutes, with a distance of 34 cm. in 70 minutes, with a distance of 41 cm. in 105 minutes, etc. He gives as an example a tumor of the breast to be irradiated over a single field at a distance of 75 cm. The table shows a time of 350 minutes for this distance. But if instead of being given continuously the dose is divided into a series of daily doses, it is necessary to add about 75 per cent to this to get the true time for an erythema dose. This gives 612 minutes, or 10 hours in round numbers. This may be divided into 15 irradiations of 40 minutes each, one given daily for the first seven days. In this way the whole treatment may last 20 days without ever having attained a true erythema dose but only a distinct browning of the irradiated region. After 20 or 25 days, or even a month, five or six more irradiations may be given daily or on alternate days. For about two years the author has used this method and in some cases has seen nodules as large as small oranges which had developed after a previous operation disappear completely, though a preceding irradiation with a single large dose had had no effect. Details of the selection of fields and distribution of irradiations for other forms of tumor are given, and six plates showing histological pictures of various forms of tumor and the position of the patient during irradiations. He finds that sarcomata are more resistent to irradiation than carcinomata.

Roffo, A. F. The action of the roentgen ray on cholesterin. *Compt. rend. Acad. d. sc., Par.*, 1925, clxxx, 228–229.

Chloroform solutions of cholesterin (0.02 per cent) were subjected to the action of the roentgen ray (200 kv., 4 ma., distance 0.17) without filter for one hour, in which time the cholesterin was entirely destroyed. The chloroform remained unaltered, however. Even after evaporating to dryness and taking up again with chloroform, tests for cholesterin were negative. Solutions in benzine gave the same results. The direct action of the roentgen rays on crystalline cholesterin was without effect, even after six hours' exposure; the physical constants remained unchanged. The use of short or filtered rays has no effect on the dissolved cholesterin. The oxidizing action of ozone, even when passed through solutions of cholesterin for one hour, was without effect; nascent oxygen was also without effect on the cholesterin.

Rump, Walter. Constant continuous tension in the production of *x*-rays. *Brit. J. Radiol.*, October, 1925, xxi, 172–177.

It has been shown that with commercial frequencies of 50 per second and relatively small capacities it is possible to produce a current of momentary constant potential for the excitation of roentgen tubes. Measurements show that the unfiltered beam of roentgen rays produced by a constant tension apparatus is consistently more homogeneous and harder than that obtained under similar conditions with a pulsating current, while in the case of the beam emerging through 0.3 mm. zinc and upwards, no difference in the hardness is noticeable. The peak value of the voltage curve of a pulsating current is therefore a measure of the hardness of the radiation it produces.

Measurements made upon the constant direct current apparatus show that when the tube current is increased the ionization current increases to a maximum and then decreases, the curves resembling parabolas. The elevation and position of the maximum and the current intensity at which ionization becomes o increase with the increased primary voltage. Variations of capacity are unimportant.

Saralegui, J. A. Study of the biological action of roentgen rays on living cells. *Semana med., Buenos Aires*, Aug. 20, 1925, xxxii, 429–435.

Schwars' lecithin theory was for some time accepted in explanation of the biological facts observed in roentgen treatment. This theory is that the rays change or destroy the lecithin contained in the cells. It was thought that the change of lecithin into other products, among which cholin was one of the most important, was the cause of cell destruction by chemical death. Others believed that lecithin is a substance indispensable for the life of cells, so that its destruction causes their death. But experiments have shown that the retardation of cell growth is as

great when spermatozoa, which are poor in lecithin, are irradiated as when ova, which are rich in lecithin are treated. Further experiments have shown that the part of the cell that is attacked by the rays is the nuclear substance.

Bergonié and Tribondeau found that the radiosensitiveness of a cell is greater, the greater the reproductive power of the cell, the greater its karyokinetic evolution and the less differentiated it is. It was formerly thought that there was a sarcoma dose, a carcinoma dose, etc., but it has now been found that there is not a fixed dose for any given type of tumor, and that the cure of a tumor is not directly due to the destruction of the tumor cells, but is a more complex process. The cell may continue to live but its reproductive power may be destroyed and this destruction of reproductive capacity depends not only on the size of the dose given but also on the stage of development of the cell when it is acted upon.

Not only must the tumor cells be killed, but the natural defenses of the organism must be stimulated; that is, the new formation of connective tissue must be stimulated. The fibroblasts are an important part of the defensive power of the body. The latent period which follows an irradiation is due to the cells which have not been killed but whose reproductive capacity has been destroyed. During their life the effect of the irradiation does not become manifest.

Treatment by roentgen rays of animals that have been inoculated with tumors has shown that the resistance to tumor of the animal may be greatly increased by such irradiation, and therefore it would seem that roentgen rays may be useful in the prophylaxis of cancer. Experiments with rat tumors have shown that heredity is important in cancer and this is shown by human statistics also.

SCHOENHOF, CLARA. Roentgen-ray action and tumor formation. *Med. Klinik*, 1925, xxi, 1302–1306; 1350–1352.

A consideration of the facts bearing on the subject shows that there is as yet no evidence justifying the belief that there are gynecological roentgen tumors analogous to those produced on the skin by roentgen rays. Neither the tumors arising after irradiation of the genital organs nor the genuine roentgen tumors support the assumption of a general effect of roentgen rays in the sense of producing a disposition to cancer. Before roentgen irradiations are given for the treatment of uterine bleeding, if the bleedings are not completely typical of those due to myoma, it is advisable to make an exploratory curettage of the cervix of the uterus and a separate one of the corpus.

Although a relationship between cancer genesis and gynecological roentgen therapy is denied, it is nevertheless a desirable thing to follow up for a number of years women who have received roentgen treatment.

SEEMANN, H. Standards of quality of roentgen rays. *Klin. Wchnschr.*, Dec. 24, 1925, iv, 2496–2497.

The unit of dose of roentgen rays is a physical concept which can be best compared with the kilowatt hour. Radiation dose signifies electrical work. It is consequently a measure of quantity which is precisely defined by the number of units. Quite different is the characterization of quality. A single number is not sufficient. It is no more fair to characterize the average beam of roentgen rays by its average wave length than it would be to characterize the spectrum of sunlight by its average wave length, which is 0.5, and corresponds to the color green. Hardness and softness of roentgen rays are actually differences in wave length as we all know, but it still remains a practice in roentgen therapy to measure this hardness and softness by penetration through a metal screen, and it is not at all true that there is a linear parallelism between penetration and wave length where a composite beam is measured. The metallic filter which gives a measure of the half-value of the beam of roentgen rays (i.e., that thickness of filter which reduces the intensity of the average beam by one-half) gives no information as to the width of the spectral interval delivered by the roentgen tube, for as has been stated, a spectrum cannot be characterized by a single value. It is necessary to apply the roentgen spectrograph for studying such matters just as the ordinary spectroscope is necessary for study of visual light.

The above appears almost self-evident but it is nevertheless very difficult to persuade the medical public of the impossibility of characterizing quality of roentgen rays by the older standards. An experience of twelve years justifies the author in the conclusion that ionization spectrometers possess so many technical disadvantages that they are decidedly inferior to the roentgen spectrographs. The latter in addition to all the theoretical advantages possesses the very decided one that it yields a permanent record. Not only is substitution of filter analysis for spectrometry impossible but the same may be said about voltage measurements whether through measurement of the minimum wave length of the spectrum or through some electrical means.

SGALITZER, MAX. Roentgen examination in the sick room of patients difficult to move. *Zentralbl. f. Chir.*, Aug. 8, 1925, lii, 1778–1782.

Patients difficult to move, especially with fractures of the lower extremities under extension, can now be conveniently studied roentgenographically, thanks to improvements in roentgen apparatus which permit such examination to be made in the patient's room. This has been found useful in the accident station of the Vienna Surgical Clinic. The apparatus described and discussed is the "Explorator" of Siemens and Halske. For purposes of roentgenoscopy an installation is provided which can be placed underneath the bed of the patient.

The bedspring intereferes to a slight extent but the contours of the bone are quite clear and so far as concerns reposition of fractures this interference is negligible. This interference is of course eliminated when roentgenograms are taken; because the film can be placed between the body and bedspring.

In the case where it is necessary to make examinations of soft tissues like the lung, heart or gastrointestinal tract, the interference is such that roentgenoscopy is practically impossible but sufficiently clear roentgenograms can be taken for all necessary purposes; or else the patient is slid on to a wooden table placed at the same height as the bed, and examined on the table.

SICILIANO, LUIGI. Methods of measurement in practical radiotherapy. *Radiol. med.*, November, 1925, xii, 769–778.

A comparison made by Siciliano of the results of ionometry with Solomon's apparatus with those furnished by Sabouraud and Noiré's radiometer confirmed the observation which had been made previously that the Sabouraud pastille is more sensitive to the softer rays. Nevertheless if this fact is taken into consideration it is possible to establish a relation between the indications given by the pastille and the biological reactions of the skin for rays of different hardness, and it is even possible to continue using the pastille for hard and strongly filtered rays.

When hard, non-filtered rays are used it is a striking fact that though these rays present considerable biological differences from rays of the same hardness filtered, yet they behave in almost exactly the same manner so far as physical measurement is concerned, which would hardly be expected, considering the fact that the non-filtered rays contain a large percentage of soft rays.

As to the method of reading the pastille, Siciliano believes that natural light is preferable, providing the fact is borne in mind that the change in color takes place about three times as quickly in artificial light as in natural light. In comparison with ionometric measurements the old colorimetric methods of Sabouraud and Noiré, Holzknecht and Bordier have the advantage of simplicity and greater sureness of dosage, because they make it possible to measure quantitatively the whole of the dose that has been given.

STRASSMANN, ERWIN. Circulatory changes during climacterium and castration, especially in myoma. *Arch. f. Gynäk.*, September, 1925, cxxvi, 169–232.

A careful study was made of 140 women treated in the University Female Clinic, Berlin. Of these, 83 were operated on and 57 received ambulant roentgen treatment. Sixty-five of the patients had myoma of the uterus, and 75 had other gynecological diseases. The conclusions of this study are as follows: During natural climacterium the blood pressure is increased on the average 20 mm. Hg (in many cases very much higher, in other cases not so high). This increase in blood pressure leads in 15 to 20 per cent of all such cases to enlargement of the heart which is to be considered a primary hypertrophy with an eventual secondary dilatation. These characteristic changes should be termed "climacteric blood pressure" and "climacteric heart."

The effect of myomatous conditions upon the heart and blood vessels has up to now not been definitely determined, because of the effect of hemorrhages and climacterium. The blood pressure in not strongly hemorrhagic myomatous cases is on the average 20 mm. Hg higher than normal, in many cases very much more. Women with myomas usually have the same blood pressure upon entering the menopause that other women have during climacterium. Forty per cent of all cases of myoma have a pathologically enlarged heart as a result of increased blood pressure. Fifty per cent of the cases of myoma during the climacterium have enlarged hearts as compared with 38 per cent of those in normal climacterium. The hemorrhages are not the cause of enlargement of the heart. The size of the myoma has no relation to the circulatory disturbances. The fact that myoma disappears following roentgen irradiation of the ovaries, and the fact that circulatory changes in myoma are similar to those in climacterium indicate that the symptoms of myoma are due to ovarian disturbances. The concept of "myoma

heart" is justified and it has its complement in "myoma blood pressure."

The immediate effects of operative and roentgen castrations are as follows: Following all operative castrations there occurs a decrease in blood pressure which reaches its lowest point in eight to ten days. This pressure loss is 0 in conservative operations, and goes to 11 mm. Hg in myoma enucleations, and finally up to 19 mm. Hg in total extirpations of the uterus with removal of the adnexa. Following all irradiations for the production of an artificial climacterium there occurs a blood pressure decrease which reaches its lowest point for systolic pressure after the second sitting and for the diastolic pressure after the last irradiation. The systolic depression in short treatments is 3 mm. Hg and with an ovarian dose, 19 mm. Hg.

The permanent effects of operative castration upon the circulation are as follows: In menstruating women operative castration produces an average increase in the systolic blood pressure of 32 mm. Hg and in the diastolic pressure of 15 mm. Hg. In climacteric women operative castration produces no change in the blood pressure. The average blood pressure increase by operative castration in menstruating women is about 15 mm. Hg higher than that found in natural climacterium. In conservative operations (the uterus and at least one ovary remaining untouched) there occurs no change in blood pressure.

The following are the permanent effects in roentgen menopause. The roentgen amenorrhea following an ovarian dose causes no increase in blood pressure either in menstruating or climacteric women, a sign that the internal secretion of the ovary remains undisturbed. Short irradiations likewise produce no after-effect on the blood pressure. The series receiving deep irradiations for malignant tumors is the only one in which in addition to amenorrhea there is a pronounced increase in blood pressure, a sign that the internal secretion of the ovaries has also been disturbed. It is only in such cases that the term "roentgen castration" is justified.

The following are the conclusions regarding therapy. In climacterics neither the operative removal of the ovaries nor the arrest produced by irradiation causes any increase in blood pressure or strain on the heart. For menstruating women the removal of the ovaries conditions a permanent and pronounced increase in blood pressure and a corresponding heart strain. The roentgen menopause, on the other hand, does not increase the blood pressure and leaves the heart undisturbed. In cases of myoma, where the heart and circulation require special consideration, roentgen irradiation is the method of choice so long as no difficulties or complications exist apart from hemorrhage.

The paper is completed by a list of 186 references.

VAN HERWERDEN, M. A. Reversible gel formation in the living cell. Change in the permeability of protoplasm by radium irradiation. *Nederl. Tijdschr. v. Geneesk., Amst.*, 1925, lxix, I, 1217–1222.

Live frog larvae, treated with 0.05 to 0.075 per cent acetic acid for twenty minutes exhibit cellular change, which can be seen under the microscope. The epithelial cells show granular cytoplasm and distinctly visible nuclei. This is due to gel formation. If the acid has acted longer, the change is no longer reversible. In frog larvae irradiated with 3.1 mg. radium bromide and treated after this with acetic acid as described above, the same visible changes occur about ten times as fast. The radiation apparently has increased the permeability of the cells for acetic acid.

VIALE, G. Radioactivity and heart function. *Arch. sci. biol., (Italy)*, 1924, vi, 209–243.

The action on the heart of salts of uranium or thorium differs from that of potassium, which has a specific exciting or inhibiting influence not possessed by either uranium or thorium. The action of potassium is, on the other hand, inhibited by the presence of uranium or thorium which emits α rays of sign opposite to that of the β rays. Sodium uranate increases temporarily the rhythm and frequency of the heart contractions and the tonus of the preparation. A heart, stopped by circulation of Ringer fluid without potassium, may be started again by sodium uranate, but this phenomenon is transient. In general, radioactivity though an important stimulus is not as necessary to organic function as is the presence of potassium.

WEBER, E., and PRELINGER, H. The unification of measurement of roentgen-ray dosage. *Med. Klinik*, Apr. 10, 1925, xxi, 549–553.

The measurement of dosage must be made along physical lines while dosage itself must be biological. Speaking from the medical standpoint it may be stated that to reproduce one's own results, as well as those of others and to apply roentgen rays as a remedy safely can be accomplished only after the establishment of the unit of dose, the concept of dosage, the quality characteristics and the maximum permissible doses expressed in terms of this unit. A table is given showing the different recommendations for roentgen treatment in metropathy, tuberculous spondylitis, and sycosis by different workers. These bring out the fact

that the physical conditions for the recommended roentgen therapy cannot be readily compared and are consequently difficult to reproduce by different workers.

The measurements of Martius indicate that the maximum skin dose lies somewhere between 500 and 600 German R for tensions of 185 to 240 kv., filtered through copper or zinc. According to Salomon, this dose is 4000 French R for very hard, strongly filtered radiations, and 1000 R for soft, unfiltered rays. The hope is expressed that we shall soon reach the point where the roentgenological dose formula will be given uniformly as in the following table:

Roentgen Factors	Units
Ray quality	λ = Å, or α Cu = Y, or potential
Filter	X mm. Cu plus 1 mm. Al
Milliamperage	a
Focal skin distance	b cm.
Field size	c sq. cm.
Number of fields with exact topographic specifications	d
Intervals between single field irradiations	e days
Dose per field	X_1 R
Dose at organ to be irradiated	About X_2 R
Total dose	About X_3 R
Interval between series	f weeks
Number of series	g

The physical aspects of the determination of roentgen-ray dose are discussed from the standpoint of a practical method of measurement. There are two important difficulties, namely, avoidance of wall radiation in an ionization chamber, and utilization of the electronic paths. This has been accomplished in the normal ionization chamber of the German Physico-Technical Institute. The result is a reproducibility not only in the measurements but in the measuring instrument itself. The latter cannot be accomplished for the French standard instrument.

In practice the calibration of a dose measuring instrument in the German Physico-Technical Institute is made at three or four different voltages and with different filters according to the following plan:

140 kv	1, 2, 3 mm. Al
160 kv	1, 2, 3 mm. Al
180 kv	0.5 mm. Cu plus 1 mm. Al
	1.0 mm. Cu plus 1 mm. Al
200 kv	0.5 mm. Cu plus 1 mm. Al
	1.0 mm. Cu plus 1 mm. Al

In practice use is made of the kilovoltmeter reading or the spark gap. Even though these may occasion perhaps a 10 per cent error, the actual error in dosage is only a few per cent, especially since the radiations are practically always delivered through a heavy filter.

WELS, PAUL, and OSANN, MATHILDE. Effect of roentgen rays on yeast cells. *Arch. f. d. ges. Physiol. (Pflüger's)*, 1925, ccvii, 156–164.

The utilization of energy by yeasts, measured in terms of oxygen consumption and CO_2 liberation, suffers no change as a result of exposure to roentgen rays, although the rate of reproduction is greatly inhibited. Obviously the point of attack of the growth-inhibitory effect of the rays does not involve the energy exchange of the cell, since inhibition of growth is possible without a primary impairment of the energy exchange. The fermentative power of yeast maceration juice is also but little influenced by roentgen irradiation.

WELS, PAUL, and THIELE, ADOLF. The effect of roentgen rays on proteins. II. *Arch. f. d. ges. Physiol. (Pflüger's)*, 1925, ccix, 49–64.

An ultramicroscopic method was employed to permit a quantitative study of the state of the protein solutions. Globulin solutions, when irradiated with doses far below the maximum therapeutic dose, show the formation of micellas or aggregates both on the acid and alkaline sides of the isoelectric point. This aggregation is therefore independent of the electrical charge which the particles originally bear. Anything altering the solubility state of the protein also changes this effect of irradiation.

WILLIAMS, MAUD. Some observations on the action of radium on plant cells. *Ann. Botany*, 1925, xxxix, 547–562.

Epidermis and attached chlorophyllose cells of petioles of *Saxifraga umbrosa* were exposed to irradiation from β- and γ-rays for varying periods. The initial effect was an increase in circulatory rate, followed by increase in amplitude of Brownian movement, suggesting lowered viscosity. Later the cytoplasm shrank away from the walls, granulation occurred, and the permeability of the protoplasm increased, while osmotic pressure decreased on account of escape of solutes. Vacuolation and discoloration occurred upon longer exposure.

The effects are in all cases irreversible. The results of treatment with β and γ rays are strikingly like those produced by the softer roentgen rays. A rather definite relation between intensity and time of exposure was demonstrated. Plant material varies widely in its susceptibility at different seasons of the year.